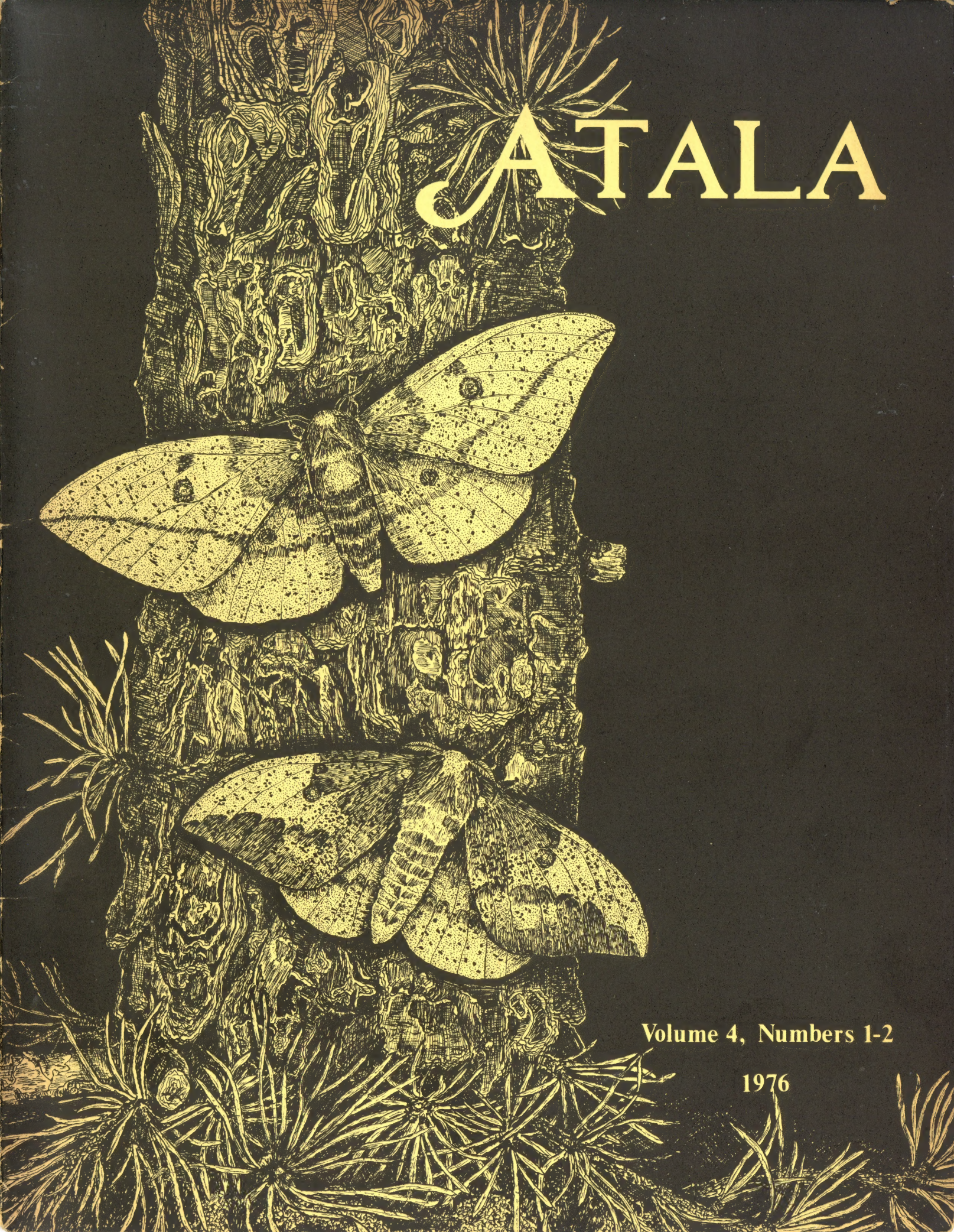


ATALA



Volume 4, Numbers 1-2

1976

THE XERCES SOCIETY

An international, non-profit organization dedicated to the conservation of terrestrial arthropods and their habitats. Named for the extinct Xerces Blue Butterfly, *Glaucopsyche xerces* (Boisduval). Founded on 9 December 1971.

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Membership in the Xerces Society is open to all interested persons and institutions upon submission of appropriate dues. Adult memberships and institutional subscriptions are US \$5.00 and student memberships are US \$2.50, for the 1977 calendar year. All members and institutional subscribers receive the journal *Atala* twice yearly; the less formal newsletter *Wings* three times yearly; *Self-Help Sheets* (informal, popular, how-to articles) irregularly, as they are issued; and Society meeting announcements, membership lists, and other communications. Xerces Society publication and administration costs are covered by dues and contributions, which are tax-deductible. A person or institution interested in receiving Xerces Society publications should submit name, address, and appropriate dues to the Treasurer, *Roger Pasquier, 235 East 73rd Street, New York, New York 10021, USA.*

Changes of address, back issues of all publications, and general correspondence about the Society should be sent to the Secretary, *Joan M. DeWind, Briggs Hill Road, Sherman, Connecticut 06784, USA.* Correspondence about terrestrial arthropod conservation issues, Xerces Society policies, suggestions for *Self-Help Sheets*, and *Atala* contributions should be mailed to the Acting Executive Director, *Robert Dirig, 807 East State Street, Ithaca, New York 14850, USA.* Less formal items for inclusion in *Wings* should be addressed to the Editor, *John F. Cryan, 807 East State Street, Ithaca, New York 14850, USA.* Contributions, questions, or comments about the 1977 Fourth of July Butterfly Count should go to the Butterfly Count Coordinator, *Mary Hathaway, P. O. Box 123, Durham, New Hampshire 03824, USA.*

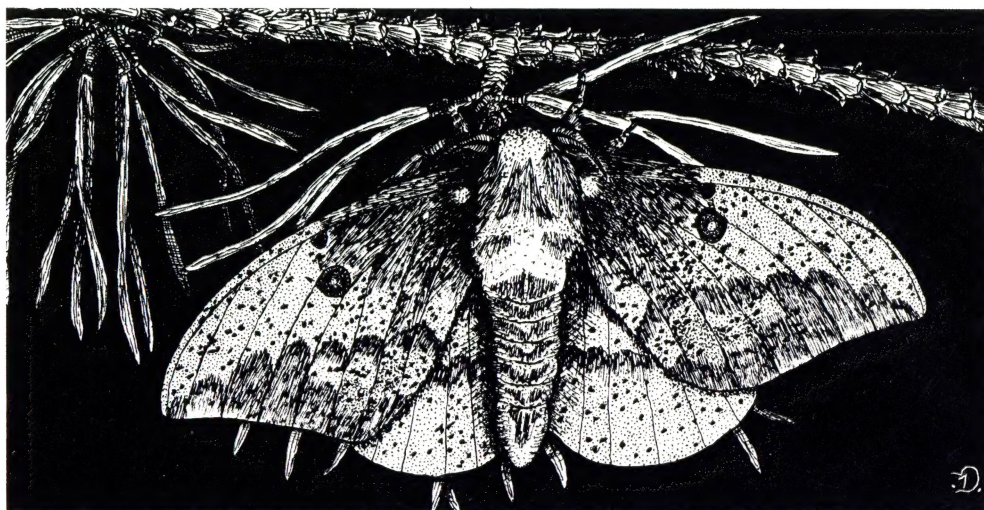
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Contents

COMMENTARY

- Presidential Message. *Robert Michael Pyle* 2

ARTICLES

- The Huleh and its Lost Aquatic Leaf Beetle. *David G. Furth* 4
Management Recommendations for Populations of the Bright Blue Copper Butterfly (*Lycaena heteronea clara*) of Southern California. *Larry J. Orsak* 10
A Preliminary Scan of Rare and Endangered Nearctic Moths. *Sidney A. Hessel* 19
The Karner Blue Project: January 1973 to December 1976. *Robert Dirig and John F. Cryan* 22

NOTES

- Butterfly Conservation Problems in the Palestinian Region. *Ichiro Nakamura* 27
Grasslands Institute, June 1976. *Robert Michael Pyle* 28
The Lepidoptera Specialist Group Holds Its Inaugural Meeting. *Robert Michael Pyle* 29
Disappearance of Lepidoptera in Indiana and Ohio. *Ray W. Bracher* 29
Symposium on Endangered Insects Held at XVth International Congress of Entomology, Washington, D. C., in August 1976. *Robert Michael Pyle* 30
A Summary of the Endangered Species Act. *Larry J. Orsak* 30
More on Dams and Butterflies. *Robert Michael Pyle* 31

BOOK REVIEW

- A New Book on *Catocala*. *Dale F. Schweitzer* 32

ABSTRACTS OF RECENT LITERATURE

ANNOUNCEMENTS AND NOTICES

Commentary

Presidential Message

Robert Michael Pyle

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This issue of *Atala* marks the fifth birthday of the Xerces Society. The idea for the Society originated on 9 December 1971, on British Rail between London and Huntingdon. That night I was full of enthusiasm for the British butterfly conservation movement, and I was anxious to provide a fulcrum for similar efforts in North America and elsewhere. Thereby, the Xerces Society came to be. But just what has it come to be, five years later?

Clearly, in our first half-decade, we have not become the pivotal force in world habitat conservation. On the other hand, we have become rather firmly established in our small corner of the conservation movement, and we have demonstrably made a difference in the course of events. I would like to take this opportunity to assess our status.

First, a word is due about the tardiness of this journal. We had hoped to adhere to a reasonably rigid schedule of publication, and in that we have failed. Tight deadlines are one thing for a journal produced by a full, paid staff; they are quite another for an entirely voluntary body made up of individuals who each have other concerns and demands. I have produced the last several issues of *Atala* at Yale University while completing my doctorate, necessarily with little help from others. This meant writing part of the copy (fortunately a diminishing amount, as good manuscripts began to come in), editing the whole, and typing photo-ready copy of the entire issue; then collating, folding, stapling, packing, addressing, stamping, zip code-sorting, and mailing the lot. It must be said in gratitude that these issues would not have been published without the help of the writers and artists, the painstaking services of Dwight Hall Press, and the labor of Sally Hughes. But the effort was intense, and it became clear that it would have to be at least partly delegated, particularly since I was leaving Yale and becoming, for a time, "of no fixed abode."

During the following peripatetic summer and autumn, production of *Atala* was not feasible for me. Then before I left the United States, Robert Dirig, Larry Orsak, and I held a very useful meeting in New Haven, Connecticut, during which we decided to allocate the duties for the creation of the overdue issues among ourselves. We decided subsequently to make it a double issue, both to get back on schedule and to mark the fifth anniversary. We think it contains some excellent and thought-provoking material, which we hope you will find interesting and useful. In the future, we hope earnestly to return to the proper publication schedule for *Atala*, which will mean the appearance of Volume 5, Number 1 in early summer.

Turning to our other regular publication, the newsletter *Wings*, we have a change to report. After creating a delightful and prompt succession of issues for several years, Jo Brewer has left that job to take on editorship of the *News of the Lepidopterists' Society*. In her place as editor of *Wings* is John F. Cryan, who has generously offered his time for that task. John is also Graphics Editor of *Atala*.

So, with the editorial position for the newsletter filled so admirably, and the duties of *Atala* dispersed among four people, I predict a satisfying resumption of Xerces Society publishing. Thank you for your forbearance during the interstice.

Besides printing the news and findings of insect conservation, what have we done in five years to justify our existence as a separate branch of the wildlife conservation field? Rather than fill space with a lengthy synopsis, I will refer you to past issues of *Atala* and *Wings* and to my North American review paper (Pyle, 1976), where specific instances are detailed. However, I would remind readers that the Society has, in several instances, affected management policies on the public lands, from New Hampshire to New Mexico, and from Ontario to Oregon. We have established a reasoned collecting policy which has reconciled apparently all but two of our members to a stand squarely behind habitat conservation as our primary goal. We have supported the Office of Endangered Species in gathering information for an intelligent listing of Threatened and Endangered United States butterflies, again stressing habitat conservation in our contributions. Without wishing to assume undue credit, we have aided the independent efforts of Charles Covell's Project Ponceanus and Robert Dirig's and John F. Cryan's Karner Blue Project. The Society has made research grants to Larry Orsak and Bruce Walsh for scientific surveys of butterfly populations of unknown status in California, and has received a grant for program development from the World Wildlife Fund. The Big Soos Butterfly Reserve, despite state tax legal difficulties, has nearly become a reality, and the awareness-raising Fourth of July Butterfly Count successfully took place for the second time this year. Through our two regular publications, the *Self-Help Sheet* series of how-to articles, and a ponderous amount of correspondence, we have generated and disseminated information on this under-reported field. And at three productive and enjoyable annual meetings, members have come together to exchange views and ideas, present and hear papers, and support the Society.

On the other side of the balance, I must candidly admit that the first five years have not been all that they might have been. Too many good ideas have been left stranded in files. Too many enthusiastic letters have waited too long for replies. And the United States Postal Service is not entirely to blame for the non-receipt of publications by some members. Without a doubt we have failed to utilize or direct the vital community component of our group to anything like its full habitat-saving capacity. I feel desperately that a tremendous amount of enthused energy is ticking over unused and unfocused. This must change if the Xerces Society hopes to achieve its possibilities. One can isolate the barriers to full realization of our potential quite clearly, and in the cold light of examination perhaps we will find our way around them. These barriers, as I perceive them, may be listed thus:

(1) FUNDS. Even since receiving our tax-exempt status, we

have been operating on a very low margin of expenditure, and publishing *Atala* always puts the treasury very near the red. We thank our donors and members warmly. We do, however, need more contributions to carry out our programs. At the present budget level we cannot even consider purchasing critical habitats. Potential new grant sources are being investigated.

(2) SIZE. Although the Xerces Society embraces insect conservation anywhere, most of our activities take place in North America. Unlike the British groups, we cannot expect the telephone, the automobile, and the train to bring us together frequently, and postage no longer is cheap. The scale of our operational arena provides another good reason for local activation.

(3) CENTRALIZATION. Quite obviously, too much of the business of the Society has depended on me for too long. This has not been by choice. As we begin to share out the responsibilities, perhaps a less erratic mode will come about. I am the first to admit that efficient management is no fit company for poverty and the graduate student way of life. And so I welcome this sixth year, during which I am taking a much lower profile in the affairs of the Society. I hope it will help to stimulate fresh new directions.

My absence has been necessitated by my wife's graduate work at the University of Leicester. We hope to return to employment in North America, at which time I hope to carry on working for the Society, at the Board's pleasure. In the interim, as well as teaching at the Vale of Catmose Village College and free-lance writing, I am chairing the Lepidoptera Specialist Group of the Survival Service Commission, IUCN, and resuming worthwhile contact with the British scientists working to understand and conserve rare insects. This interlude in the English countryside, with its many public footpaths, public houses, and overwintering Peacock Butterflies (*Nymphalis io* (L.)), promises to be most refreshing. I am very grateful to Robert Dirig for accepting the Board of Directors' invitation to serve as Acting Executive Director for one year. Please address Xerces Society business and *Atala* contributions to him for the time being. I will, of course,

welcome any correspondence with which I may be able to help. Our addresses appear on the inside back cover.

Reflecting on the first five years, I would say that I am reasonably pleased, if not altogether satisfied, with the progress of the Xerces Society. I am convinced that for it to achieve its real potential as a catalytic, action organization, in order to save many more butterfly habitats, the Society genuinely needs a full-time, adequately paid, and professionally qualified executive officer, with a small auxiliary staff and an established office in a communications center. That is the minimum basis from which most of the successful and influential conservation groups work. Having seen the underbelly of operations in temporary, ad hoc situations for five years, I think I can state this opinion free from suspicion that we "just want to be like the others." Also, as I will not be in contention for the job thus created, I feel I can advocate this step without fear of my motives being misunderstood. Realization of this modest, but altogether necessary development may be some years away; I strongly hope that it may come about before the Society reaches its tenth anniversary, another five years hence.

The human pressures on rare terrestrial arthropods and their habitats are critical and exacerbating. If public and governmental awareness of their plight and importance has truly increased, it can be laid largely to the credit of the Xerces Society. Now we need to seize that awareness and from it build a really satisfactory framework of protected habitats. We need to give every Xerces Society member something positive to do with his or her energy and interest. Above all, we need to develop fresh and effective means of translating that enthusiasm into genuine conservation results.

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Articles

The Huleh and its Lost Aquatic Leaf Beetle

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Abstract

Much of the biological history and literature of the Huleh Lake and Swamps in the upper Jordan (Rift) Valley of Israel is reviewed. Prior to its drainage in 1951-1959, this unique aquatic habitat supported a considerably larger fauna and flora, especially tropical (Ethiopian) species. The transitions that this aquatic habitat went through before, during, and after its drainage are mentioned. A small section of the former lake and swamps was salvaged and established as a Nature Reserve in 1959.

Subsequent to early threats of drainage, several attempts were made to survey the flora and fauna of the Huleh; only the flora was significantly studied. Consequently, the opportunity to gather biological and ecological information about much of the Huleh fauna was lost after its drainage. An example is the probable extinction of the isolated Huleh population of the semi-aquatic, primarily Euro-Siberian leaf beetle *Donacia bicolor*. The extinction of this *Donacia* population was apparently caused by the nearly complete extermination of its hostplant, *Sparganium neglectum*, as a result of the drainage. Some general biology of the genus *Donacia* is presented, along with the first record (1863) of a second species (*D. thalassina*) from the Huleh. Since 1971, the Huleh Nature Reserve has undergone rehabilitation in an attempt to restore habitat and biota closer to that existing before its drainage.

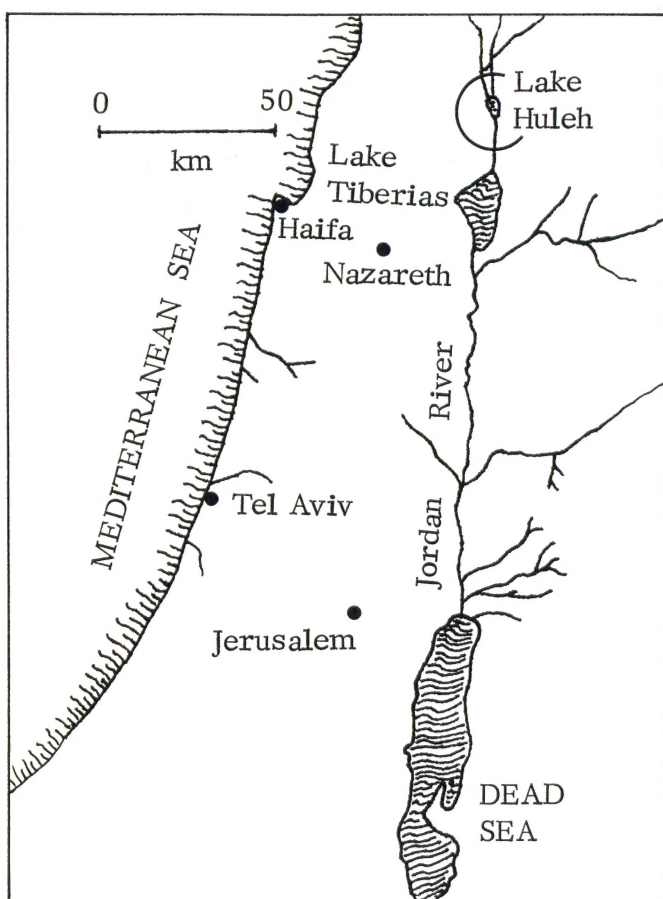


Figure 1: Jordan River System and location of Lake Huleh (after Kugler & Wool, 1968).

Introduction

In the land of the Bible existed a mysterious lake surrounded by extensive swamps known as the Waters of Merom. Aside from its Biblical mention, few travelers to the Holy Land have mentioned it and even fewer have recorded any aspects of its natural history. In more recent times, this area has been known as the Huleh (or Hula) Lake and Swamps (although "Swamps" is used throughout this paper, the Huleh wetlands were actually marshes in the technical sense). The Huleh Lake was at the head of the Jordan Valley where the major sources of the Jordan River merged (Fig. 1). It was the major part of the narrow Huleh Plain or Valley set between the eastern, high, basaltic plateau of the Golan Heights and the western, limestone, Upper Galilean mountains located in present-day Israel. The lake's surface was 67 meters (220 feet) above sea level, as opposed to its southern neighbor, Lake Tiberias (Sea of Galilee), which is 212 meters (696 feet) below sea level.

The Huleh's unique environment provided a refuge for many unusual plants and animals, including some endemics. Of special interest is the fact that the Huleh (as well as other parts of the Jordan Valley System) was and still is a refugium for a surprising number of tropical African (Ethiopian) plants and animals; this is presumably because the Jordan Valley is part of the Great Rift Valley of East Africa. The Huleh was the largest hydrophytic area in Palestine and Syria (Zohary & Orshansky, 1947). In spite of its large size and biological uniqueness, little scientific investigation took place there until relatively recently.

Why all the mystery and paucity of biological knowledge? The vast marshes surrounding Huleh Lake were so dense with various reeds, rushes, and other vegetation that most of the area was virtually impenetrable to explorers. Another major reason was the presence of the malaria mosquito in the marshes. Neither of

these reasons seemed to daunt the Jewish and Arab peasants who lived nearby. Even the Canon H. B. Tristram, in the first great biological treatise on the region (Tristram, 1884), recorded very little concerning the biota of the Huleh because he could not penetrate the area. Around the turn of the century, a few naturalists managed, with difficulty, to explore the area, and recorded details of the existing biota (Barrois, 1894; Annandale, 1913, 1915). However, it was not until the threat of drainage of the Huleh Lake and Swamps in 1934 that a series of comprehensive scientific investigations took place.

Because of the intentions to drain the area, many scientists became alarmed at the potential massive extinction of many endemic populations of exotic plant and animal species. As a result of this concern, the 1935 Percy Sladen Expedition of Lake Huleh took place. This was a small but rather intensive investigation conducted by a zoologist, R. Washbourn, and a botanist, R. F. Jones, both from England. The resulting samples were analyzed by various specialists, mostly from the British Museum of Natural History (Washbourn & Jones, 1936, 1938). Jones (1940) published the first botanical study of the Huleh, including detailed ecological information. Since this investigation, a series of studies on the fauna, flora, and physical environment of the Huleh Lake and Swamps has been carried out. Nevertheless, these studies were insufficient; in 1951, drainage plans were finalized, and the slow process was completed by 1959. Fortunately, a small section of the former Huleh Lake and Swamps was salvaged, and established as a Nature Reserve.

Below I will discuss the past extent, size, and character of the Huleh; the effects of the drainage of Huleh Lake and the surrounding wetlands on the biota; the apparent drainage-caused extinction of the isolated Huleh population of the leaf beetle *Donacia bicolor* Zschach; and the establishment of the Huleh Nature Reserve.

Past Extent, Size, and Character of the Huleh

The heart-shaped Huleh Lake covered about 15 square kilometers (6 square miles) and the swamps about 30 square kilometers (12 square miles) (Fig. 2). As mentioned above, primary inflows of water were the Jordan River source streams, as well as several springs, most notably Ein Einan (also called Wadi el Barid or Ein Melaha). The swamp area varied in size with the season, expanding during winter floods and shrinking during arid summers. Throughout the swamps were pools of various size and channels of open water, but most of the area was dominated by jungles of Papyrus (*Cyperus papyrus* L.) reaching 5 meters (16 feet) in height on peat soils, as well as *Polygonum acuminatum* Kunth, *Phragmites communis* L., and others. Sometimes the rhizomes of these plants, especially Papyrus, formed "islands" dense enough to support humans.

Jones (1940) mapped the ecological plant associations of Huleh Lake, and Zohary & Orshansky (1947) mapped the swamps. Many plant associations were present, all influenced by local ecological conditions. Many of these communities were eliminated or severely restricted after drainage of the lake and swamps (Paz, 1976). Water depth in the Huleh varied between 1 and 3 meters (3 to 10 feet), with a silt and mud bottom and basaltic pebbles on the eastern shores. The relative shallowness of

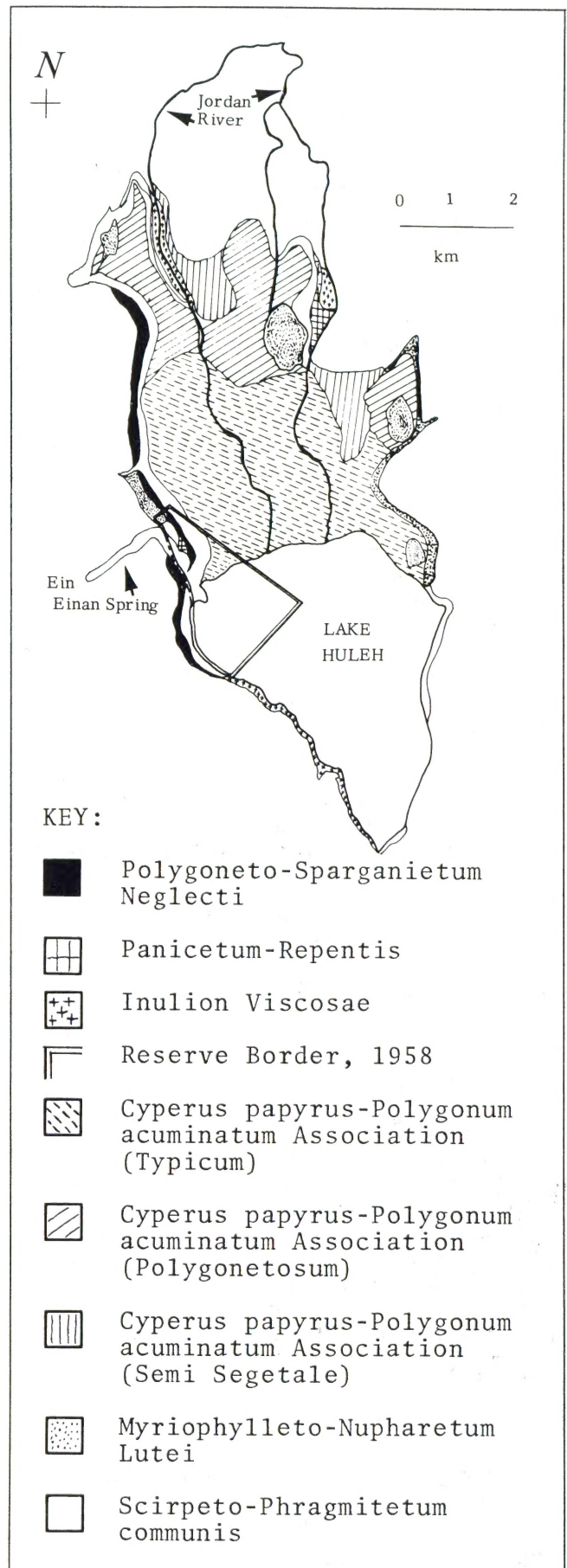


Figure 2: Huleh Swamp vegetational associations (after Zohary & Orshansky, 1947).

the lake prevented stratification into warm epilimnion and cold hypolimnion (Jones, 1940). Both the lake bottom composition and depth apparently affected the ecological plant associations (Paz, 1976). There were distinct differences in water quality between the swamps and the lake (Jones, 1940). The lake had approximately six times more oxygen than the swamps, a higher, alkaline pH of 7.9 in contrast to 7.3 in the swamps, and higher water temperature, less salinity, and less organic matter.

Those ecological factors which affected the plant associations probably also directly affected even non-phytophagous animals. Herbivores were often distributed in the Huleh according to the distribution of their foodplants. This type of relationship may have been so inflexible that when the host was endangered or eliminated, so was the herbivore.

The Huleh Valley was, and to some extent still is, the northernmost enclave for many tropical African (Ethiopian) biotic elements. In his classic work on the fauna and flora, Tristram (1884) first recorded the surprising amount of tropical African biotic elements in Palestine (comprising 30 percent of Palestinian mammals, for example). Tristram, Annandale (1913), and others claimed that no distinctly Ethiopian invertebrate elements were present in Lake Tiberias (Sea of Galilee). However, after further study, Bodenheimer (1935) demonstrated a rather high percentage of Ethiopian invertebrate species in some groups, especially insects (e.g., Orthoptera and Odonata). Ethiopian species were also found in vertebrate groups such as mammals, breeding birds, and fresh water fishes. He illustrated the unique zoogeographic position of Israel as a crossroads of various sections of the Palearctic and Ethiopian Regions. I have summarized much of the biogeographic information about Israel, including some relatively recent extinctions (Furth, 1975).

Bytinski-Salz (1961) noted that among insects, the Ethiopian species are migrants, are associated with fresh water, or are dependent on Ethiopian hostplants. These three factors probably have played and are playing an important role for many other Ethiopian animals in the Huleh Valley. The percentage of Ethiopian biota in the Jordan Valley Rift System is much higher than for Israel as a whole; examples include various species of *Acacia*, the African Monarch Butterfly (*Danaus chrysippus chrysippus* L.), and the Leopard (*Panthera pardus* L. — now endangered there). Kugler & Wool (1968) discovered that over 50 percent of the midges (Diptera: Chironomidae) in the Huleh Nature Reserve during 1965-1966 were Ethiopian elements. These included some species not found in larger Lake Tiberias which lies just to the south in the Jordan Valley and has a milder climate. There may have been even more tropical midges in the Huleh prior to its drainage; we will never know. Perhaps the two most integral elements in the pre- and post-drainage of the Huleh are tropical African species — the cichlid fishes (*Tilapia* spp.), now a mainstay in the fish industry there, and the legendary Papyrus that still dominates the Huleh Reserve. Thus the former Lake Huleh and Swamps were, and to a lesser extent still are, the northernmost locality in the Great Rift Valley for many Ethiopian species.

The Effects of Drainage on Huleh Biota

Human impact in the region was noticeable even before drainage of the Huleh. In the 13th century the Mamluks built a bridge over the narrows of the Jordan River (south of the Huleh) and this had a damming effect, raising the water level. In the early 1900's this effect was diminished when the bridge was widened



Figure 3: *Donacia bicolor* Zschach.

(Paz, 1976). Villagers around the Huleh engaged in a small fishing industry, massive harvest of Papyrus for huts or various woven products, and the domestication of large numbers of Water Buffalo (*Bubalus bubalis* L.) (Washbourn & Jones, 1938). These activities all had distinct effects on the ecology and structure of the lake and swamps, but were not nearly as damaging as the drainage during the 1950's.

Why were the Huleh Lake and Swamps drained between 1951 and 1959? The reason was two-fold: to attempt eradication of malaria, and to reclaim arable land for new settlements. The incidence of malaria was once as high as 30 percent among Jewish settlers. By 1945, due to the introduction of certain mosquito-eating fish (*Gambusia* spp.) and the extensive use of proper clothing and netting on dwellings, the malaria rate had dropped to three percent (Paz, 1976). DDT, which I have seen used indiscriminately by the Israel Ministry of Health to control malaria-bearing anopheline mosquitoes (Furth, 1969), was applied to the Huleh in 1946, and malaria cases in the region were reduced to less than one percent (Paz, 1976). It is quite possible that subsequent indiscriminate use of DDT in the Huleh may have caused eradications of other aquatic invertebrates before the drainage. It is apparent, as Paz pointed out, that malaria was actually sufficiently suppressed before the drainage commenced. Much of the land reclaimed through Huleh drainage was of little agricultural use. Thus, it appears that the drainage and its consequent prodigious reductions and extinctions of many endemic populations of plant and animal species was mostly a folly.

Effects of the Huleh drainage are too numerous to list fully here, but I will mention some of the more important ones. This paper testifies to the fact that these effects are still coming to light.

Drainage created vast areas of dried swamp vegetation (formerly inundated by water) which in 1960 ignited and burned one-third of the Huleh Reserve (Paz, 1976). Very few of the diverse hydrophytic plant associations remained, and many characteristic plants were eliminated, such as *Marsilea*, a tropical fern; *Nymphaea*, a water lily; *Utricularia*, a bladderwort, and the only carnivorous plant; *Iris*; etc. (Paz, 1976). Many plants formerly confined to discreet sections of the Huleh Valley spread over large areas, including *Tamarix*, *Ficus*, *Cyperus papyrus*, *Phragmites communis*, and others, which created completely new, undesirable associations.

One of the most important changes after drainage was in water quality, particularly increases in salinity, hardness, and amounts of soluble and suspended solids (Paz, 1976). This greatly affected the entirely or partially submerged vegetation, as well as the animal life. Gone were many planktonic associations and various shoreline communities and associations.

Many fish species were eliminated after drainage, leaving a very unbalanced and somewhat detrimental association. One of Israel's few endemic vertebrates, a frog (*Discoglossus nigriventer* Mendelssohn & Steinitz), described in 1940, has not been seen since 1955, and is very possibly extinct (Paz, 1976). Many species of waterfowl no longer breed in the Huleh Reserve, but still survive in other parts of Israel or in nearby commercial fish ponds (Zahavi, 1957). Other species no longer breed at all in Israel, since their habitats in the Huleh were destroyed. Mammal diversity and abundance has also been greatly altered by drainage.

Apparently little is known about effects of the drainage on the invertebrate fauna. This is largely due to lack of pre-drainage surveys and research. Among the insects, only recent study by a few specialists in appropriate groups has uncovered some evidence of possible extinctions. The Belgian odonatist H. Dumont has indicated (*in litt.*) that the subspecies of two tropical African libellulid dragonflies (*Rhyothemis semihyalina* Desj. and *Urothemis edwardsi* Selys) which occurred in the Huleh are probably extinct. A spongillafly of the order Neuroptera (*Sisyra trilobita* Flint) that parasitizes sponges is known only from the Sea of Galilee, and may now be extinct there due to recent water quality changes (J. Kugler, personal communication). Since sponges did exist in the Huleh Lake (Barrois, 1894; Washbourn & Jones, 1938), it is possible that this spongillafly was also living there; if so, it is probably extinct.

Apparent Extinction of *Donacia bicolor*

There is evidence for the extinction of the Huleh population of a semi-aquatic leaf beetle, *Donacia bicolor* Zschach (Coleoptera: Chrysomelidae: Donaciinae) (Fig. 3), which is recorded from Europe to Siberia, southeast to Turkey, Caucasus, and Israel. This species was last collected in the Huleh by H. Bytinski-Salz, between March and May 1942, 1945, and 1946, on *Sparganium neglectum* Beeby. Another rather mysterious record is from the North Coastal Plain of Israel, in July 1940. These specimens are in the collections of Professor Bytinski-Salz and Tel Aviv University. Recently I discovered a specimen of *Donacia* at Harvard University's Museum of Comparative Zoology, collected in the Huleh, 1863-1864, by B. Lowne; however, this specimen was apparently correctly identified as *D. thalassina* Germer, a very close relative of *bicolor* known to occur in association with *Scirpus lacustris* L. in Europe. This is another mysterious record, and both unusual records warrant further investigation. It is quite possible that more than one species of

Donacia existed in the Huleh at one time, since most of the worldwide genera of hosts (listed below) of all species of *Donacia* grew in the Huleh before drainage.

There have been no Huleh records of *D. bicolor* since 1946, and it seems very likely that this beetle may have become extinct (or nearly so) after the Huleh drainage. Even though no one may have been expressly searching for it during the last 30 years, its bright metallic green or coppery-green color, as well as its relatively large size (up to 11 millimeters, or about 0.5 inch) should have made it apparent were it still extant.

Donaciinae is a primitive, well known, semi-aquatic, primarily Holarctic subfamily of the leaf beetle family Chrysomelidae. *Donacia* is by far the largest genus. These beetles are of little economic importance except as minor pests of cultivated rice in parts of the Far East (Jolivet, 1972a). Their host preferences are usually rather specialized, at least to host genus; however, some feed on several hosts, whereas in others one host species may support several donaciine species (Marx, 1957). According to Hoffman (1940b) and Mohr (1966), the following host genera are known for most Holarctic *Donacia*: *Alisma*, *Baldingera*, *Buto-mus*, *Carex*, *Castalia*, *Eleocharis*, *Glyceria*, *Myriophyllum*, *Nuphar*, *Nymphaea*, *Phragmites*, *Pontederia*, *Potamogeton*, *Ranunculus*, *Sagittaria*, *Scirpus*, *Sparganium*, and *Typha*.

The larvae spend their entire existence submerged eating leaf petioles, stems, or roots. Some *Sparganium* feeders feed between two overlapping leaves. In order to feed under water they have specialized caudal spines on their dorsal side with spiracles at their bases (Leech & Chandler, 1963) (Fig. 4). This spine is used to puncture submerged plants and take air from the plant tissues through the spiracles (Jolivet, 1972a). Hoffman (1940a) also discovered that cutaneous respiration exists in the larvae. The larvae in most regions overwinter in the later instars, but in a few species, the adults overwinter (Jolivet, 1972b; and Hoffman, 1940a).

Waterproof silken cocoons for the pupae, possibly spun from oral glands or short Malpighian tubules, are placed on the punctured sites, usually near where the larvae fed (Leech & Chandler, 1963; Arnett, 1968). The pupal stage is of variable duration, but may last almost one year.

The bright, metallic-hued beetles usually feed on the exposed parts of the host, but a few species eat pollen, and some are known to spend their entire lives submerged. Adult respiration under water is accomplished by oxygen diffusion from the thin film of air captured over most of the body of the beetle by tiny hydrofuge hairs. This air film is often spread over the body by the antennae (Arnett, 1968). The adults often are rather specialized ecologically and ethologically, and often occur in somewhat

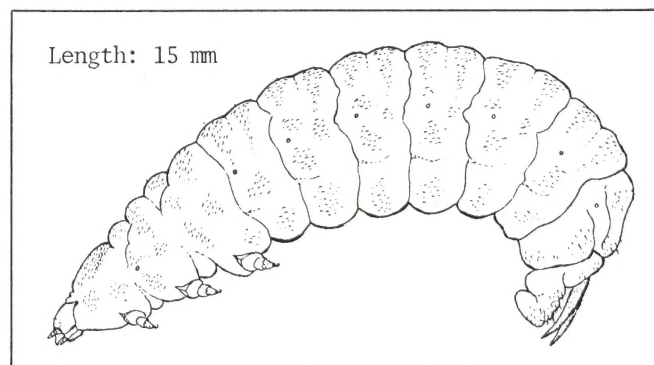


Figure 4: Larva of *Donacia* (after Peterson, 1960).

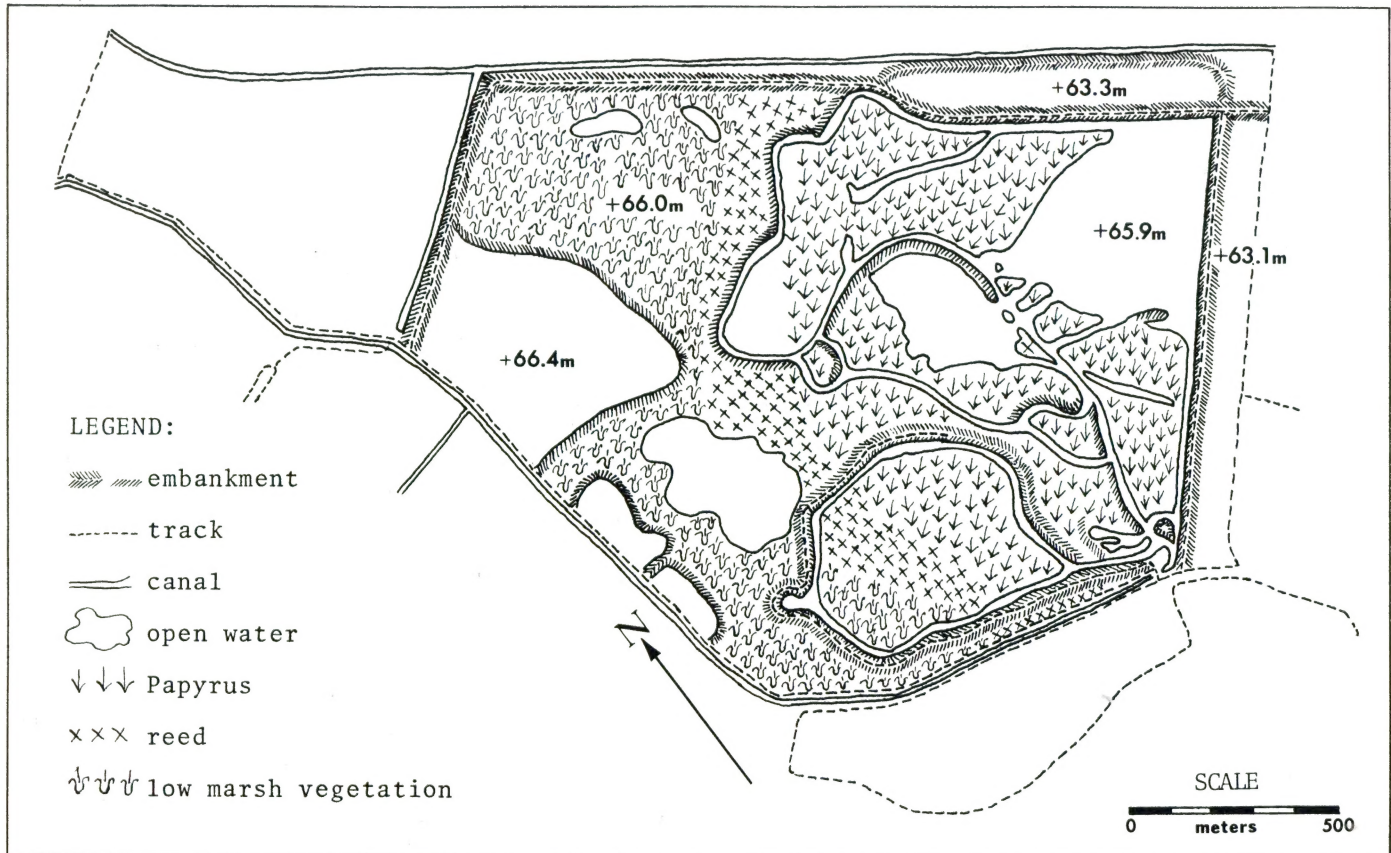


Figure 5: Huleh Nature Reserve development plan, situation after reconstruction (after Paz, 1976).

localized populations. Adults of many species of *Donacia* are known to be efficient fliers that flush easily (Marx, 1957). Eggs are deposited beneath the water surface. The life cycle may last two years in some species, and there may or may not be distinct broods present (Hoffman, 1940b). One Palearctic donaciine species breeds in fringe marine waters -- very unusual for Coleoptera (Jolivet, 1972a).

The best evidence for the local extinction of *Donacia bicolor* comes from its specialized biology and close ties with the hostplant *Sparganium neglectum*. This plant was part of a relatively small ecological plant association in the Huleh Swamps and in parts of the lake near arable land. This association extended 50-100 meters (164-328 feet) across, occurred mainly on the western and some eastern fringes of the reed (*Phragmites*) belt, and was associated with *Polygonum acuminatum* (Zohary & Orshansky, 1947) (Fig. 2). This plant is also associated with the edges of newly-formed swamps. This was one of the plant communities destroyed by Huleh drainage, and was always somewhat susceptible to dessication during the dry seasons. Paz (1976) states that *S. neglectum* is extremely rare today, found only in the Ein Einan Spring. The plant association of the Einan is that of a flowing stream; and due to differing water quality and a different environment, *D. bicolor* may not be able to exist there. I would thus conclude that the elimination of its host from the normal habitat association probably was the primary cause of the extinction of this beetle from the unique and isolated Huleh ecosystem, combined with other limiting ecological factors affecting its life stages.

Establishment of the Huleh Nature Reserve

In 1955, while drainage was still proceeding, it was agreed to set aside a certain area of the Huleh Lake and Swamps as a Huleh Nature Reserve, as a result of pressure from nature lovers and scientists. The Reserve was planned to be 4.1 square kilometers (1.6 square miles) in area (later reduced to 3.2 square kilometers or 1.2 square miles), with water more than 2 meters (7 feet) deep, and containing many boating canals. In 1964 the Huleh Nature Reserve was officially established as the first national preserve in Israel (there are currently over 100 preserves there).

The location selected for the Huleh Reserve was the north-western corner of the former lake, an area containing the fringes of several vegetational associations of the swamps and lake. Crucial to this location was the presence of the Ein Einan Spring which provided water similar to that of the original Huleh, especially the warm temperature necessary for preservation of many tropical elements.

Putting the Huleh Reserve into operation was a difficult task due to many unexpected problems. Earth embankments created to maintain a 2-meter (7-foot) water level were improperly constructed, and much water percolated through them, significantly lowering the water level and causing dessication of preserved swamps. Attempts to alter the Ein Einan Spring for water supply caused a decreased flow, and the Reserve was initially forced to use polluted waste water from nearby fish ponds as the main water source (Paz, 1976). Problems with hunters, fishermen, fires, water quality changes, and invasions of

various escaped non-native plants made it difficult for the project to get underway. All of these problems, combined with those of the drainage, made the initial Huleh Reserve far from what was desired.

In 1971 work began on a carefully detailed plan of rehabilitation and enlargement of the Huleh Reserve. Its main objective was to recover and restock as many of the biotic associations of the former Huleh as possible. Many of the problems encountered in the beginning have been corrected to facilitate stable, controlled environments. Currently, most of the rehabilitation is completed, and several ecological associations lost after drainage have been partially reestablished (Fig. 5).

I have done a considerable amount of sweep collecting for chrysomelid beetles in and around the Huleh Reserve during 1972-1974, including the Ein Einan Spring area, without finding any *Donacia bicolor*. There is, of course, the possibility that it may persist in small numbers at Ein Einan Spring. If so, this would indicate fairly recent selective adaptation to an "unnatural environment" from ancestral stock in the Huleh Swamps. If a small population does still exist there, this beetle, along with its typical hostplant associations, might be re-introduced as a small part of the rehabilitation of the Huleh Lake and Swamps ecosystem, a fascinating part of the Jordan Rift Valley System.

Conclusion

It is encouraging to see an effort to save and rehabilitate such a special nature reserve as the Huleh; however, authorities in all preservation organizations should adopt the attitude of conserving arthropod populations and their habitats. These incredibly diverse animals are as important and enlightening as their vertebrate associates.

Acknowledgements

I would like to thank H. Bytinski-Salz, J. Kugler, and A. Freidberg, all of Tel Aviv University, for their kind assistance in gathering information for this paper. Also, thanks to Uzi Paz of the Nature Reserve Authority of Israel for providing me with a copy of his splendid work. The photograph of *Donacia bicolor* (Fig. 3) was taken by W. Sacco.

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Management Recommendations for Populations of the Bright Blue Copper Butterfly (*Lycaena heteronea clara*) of Southern California

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Abstract

A synopsis is given of habitat, behavioral, population, and other biological studies on the Bright Blue Copper Butterfly (*Lycaena heteronea clara*) conducted in 1975-1976. Ties between the butterfly and its environment are emphasized. Methods are briefly described, and results are presented in the form of habitat management recommendations dealing with habitat modification that, if initiated, could be used to enhance the density and size of existing populations (about 30 known, in southern California). Past, present, and future threats to the localized populations are noted. The research is discussed in terms of what is required to develop management recommendations, the potential uses of such recommendations, and the probability of similar recommendations being developed for other rare, threatened, and endangered butterflies. A discussion of the benefits and liabilities of habitat modification for a rare or endangered organism is presented.

Introduction

A great many butterflies are currently on the decline, their populations negatively affected by human modification of their habitats. For the majority, the population losses to date have probably not been severe. For some, however, the decimation of favorable habitat has been so widespread and drastic that the butterflies are threatened with extinction. This may be difficult for many people to believe because the "backyard" butterflies that most people notice are both widespread and abundant. Nevertheless, the remaining populations of some butterflies are truly endangered and near extinction. What can be done to improve their situation, to increase their probability of future survival? There are two possibilities. Attempts can be made either to prevent further decline of remaining populations or to enhance the size of existing populations. The latter course might be accomplished by manipulating the remaining habitat so that it can support a larger resident population, or by creating new habitat within the natural range of the butterfly so that new populations can be started via introductions. Some degree of habitat management is necessary, regardless of the alternative. Even the attempted maintenance of some populations at present levels, in the absence of any habitat modification threats, may require such management. This is particularly true for endangered organisms inhabiting vegetational communities which are not climax communities, particularly when only a small area (not large enough to encompass a heterogeneous habitat made up of all seral stages) has been set aside.

Intelligent habitat management is simply not possible without the availability of detailed information on the biology and behavior of the organism under consideration, with emphasis on the relationships of that organism to its surrounding environment. Yet, virtually nothing is known about all of our rarer North American butterflies, except for the adult flight season, general distribution, and perhaps the larval hostplant. Thus, butterfly conservation is usually easier in theory than in practice, given our

present scanty knowledge of butterfly biology. We can endlessly discuss what can be done to save populations, but until sound experiments and biological observations are made on our endangered, threatened, and rare butterflies, we will be virtually helpless to guarantee their survival, even when habitat preserves are created.

British conservationists are far ahead of their American counterparts in the assessment of habitat for rare butterflies and development of habitat management plans for these organisms. Thomas (1974) intensely studied two British hairstreak butterflies in order to determine the reasons for their rarity and decline in Britain. Likewise, Dempster *et al.* (1976) studied the habitat and hostplants of the endangered British Swallowtail (*Papilio machaon britannicus* Sietz) in an effort to explain the disappearance of this butterfly from one site and to assess the possibility of successfully reintroducing it there. Another butterfly, the Large Copper (*Lycaena dispar batava* (Oberthur)), with its one British population at Woodwalton Fen (from introduced Dutch stock), survives on habitat that has for years been artificially managed for its benefit.

It is time for American lepidopterists to follow the British example and initiate in-depth studies of our rarer butterflies. The work of Ehrlich *et al.* (1975) on the checkerspot *Euphydryas editha bayensis* Sternitzky is an outstanding example of what can be done. Perhaps not all of this work could be carried out by casual or amateur lepidopterists, yet everyone can play a role in a research program geared toward discovering more about the distribution, biology, and behavior of any rare or endangered butterfly. Non-professional lepidopterists can make basic biological observations (patience being a requisite), and can conduct searches for previously unknown populations. Other workers can conduct the autecological work needed to develop a habitat management plan.

The basic questions which must be answered through such a diverse and in-depth research program are: (1) Why is the butterfly rare, i.e., what factors limit survival, reproduction, and colonization? (2) To what components of the habitat and environment are the butterflies particularly sensitive (taking into

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consideration all life stages)? (3) To what extent can the habitat be modified without adversely affecting populations of the butterfly? (4) To what extent and in what ways could the habitat be modified to enhance the population under study?

During 1975 and 1976, I investigated the biology, behavior, and habitat of a very rare southern Californian butterfly, the Bright Blue Copper (*Lycaena heteronea clara* Hy. Edwards). Almost nothing was previously known about this butterfly. My goals were to answer the questions posed above, applying the information obtained in formulating workable recommendations for remaining populations. I report here the basic setup of the program and also the more important results, presented in the format of management recommendations. Detailed methodology and results will be published elsewhere at a later date.

The Butterfly

The Bright Blue Copper was first collected in July 1876 in Tehachapi Pass (Kern County, California). The male is brilliant iridescent blue on the dorsal wing surfaces (Fig. 1A) and chalk-white beneath with scattered black spots (Fig. 1C). The female is somewhat more drab, with extensive brown and considerably less iridescent blue scaling dorsally (Fig. 1B). The ventral surfaces of the female are slightly yellowish and usually with slightly more maculation than in the male.

When Emmel & Emmel (1973) was published, nothing was known of the early stages, a specific hostplant had not been documented, and the range was only generally defined. It was known that the butterfly was exceedingly local, that it flew from late June to August, and that only a few populations had been discovered (from which collectors obtained their series). I began with this scanty information and built upon it.

The Project

During 1975, a search for new populations was initiated, hostplants were determined, and basic biological and behavioral observations were made. In addition, the habitat of the Copper was qualitatively investigated, and a short-term mark-release-recapture study made at one site.

The 1976 study was more extensive and multi-faceted. High priority was placed upon describing the Bright Blue Copper habitat via vegetational mapping, and comparing the results from many populations studied. It was particularly important to identify the most crucial components of the Bright Blue Copper habitat -- nectar sources, specific topographic features, perching and roosting substrates, etc. This was accomplished in part by observing the butterfly at several populations, concentrating on the behavioral and biological interactions of the organism with its environment.

Populations at three sites were studied using mark-release-recapture methods in 1976, in order that adult population size, density, life span, and general movement could be compared in different locations. Laboratory experiments were conducted to determine those environmental factors responsible for breaking egg dormancy. Larval hostplants and egg placement on the hostplant were also studied, and the life history was worked out insofar as possible.

Compared with the previous season, fewer searches for new populations were conducted in 1976. This aspect of the project was still considered important, however. First, it was essential to discover additional populations that could be compared with those already known, to determine which behavioral and biological attributes and habitat components were universally

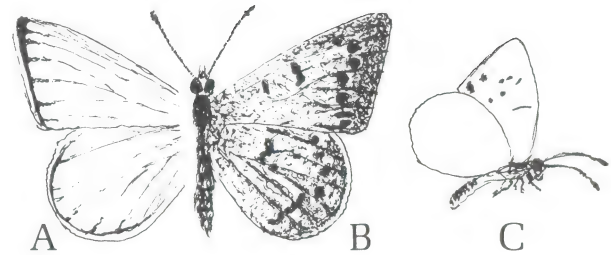


Figure 1: Bright Blue Copper (*Lycaena heteronea clara* Hy. Edwards). A. Male, dorsal. B. Female, dorsal. C. Male, ventral.

present. Second, it is and will continue to be impossible to monitor or determine the status of any butterfly without a thorough knowledge of its range and its distribution within the range. During 1976, volunteer lepidopterists were particularly helpful in exploring for new populations. This enabled me to study various aspects of the butterfly's autecology in greater detail.

Using the information obtained in 1975 and 1976, an attempt was made to locate seemingly suitable habitats within the range of the butterfly where it did not naturally occur, so that intelligent population introduction attempts could be made. One introduction attempt was made at a site in the Tehachapi Mountains.

Habitat Management Recommendations for Populations of the Bright Blue Copper

The following summarizes data collected during the two-year study. Habitat management recommendations based on this information are included. Scientific names of California plants follow Munz (1974).

Distribution, Range, Abundance

FORMER DISTRIBUTION: Isolated populations occurred on Piute Peak (north of Tehachapi) and at Silverwood Lake (in the San Bernadino Mountains); in Antelope Canyon (Tehachapi Mountains), west to Fort Tejon; Castaic, Cuddy, and Lockwood Valleys; and at Mt. Pinos (Fig. 2).

PRESENT DISTRIBUTION: As above, but there are no recent records from the Tehachapi Mountains (the last known Tehachapi records are from the early 1930's), although further exploration is needed in the eastern portion of this area. The butterfly may also be extinct in the Silverwood Lake region, since some population sites were inundated by creation of the lake (William Klein, *in litt.*). A large classic population near Lebec (Castaic Valley) was destroyed by highway construction (from Munroe Walton Field Notebook, Los Angeles County Museum). Gravel pit operations destroyed another large population in lower Cuddy Valley (Chris Henne, *in litt.*). Some destruction at the Owl's Barn population is a result of mountain cabin construction (personal observation). There has almost certainly been undocumented population elimination in both Cuddy and Lockwood Valleys and in the Tehachapi Valley region, resulting from destruction of the natural habitat in converting sagebrush to pastureland (or farms in the Tehachapi Valley). The several populations located within or at the periphery of Frazier Park are an indication that this town may rest upon former population sites.

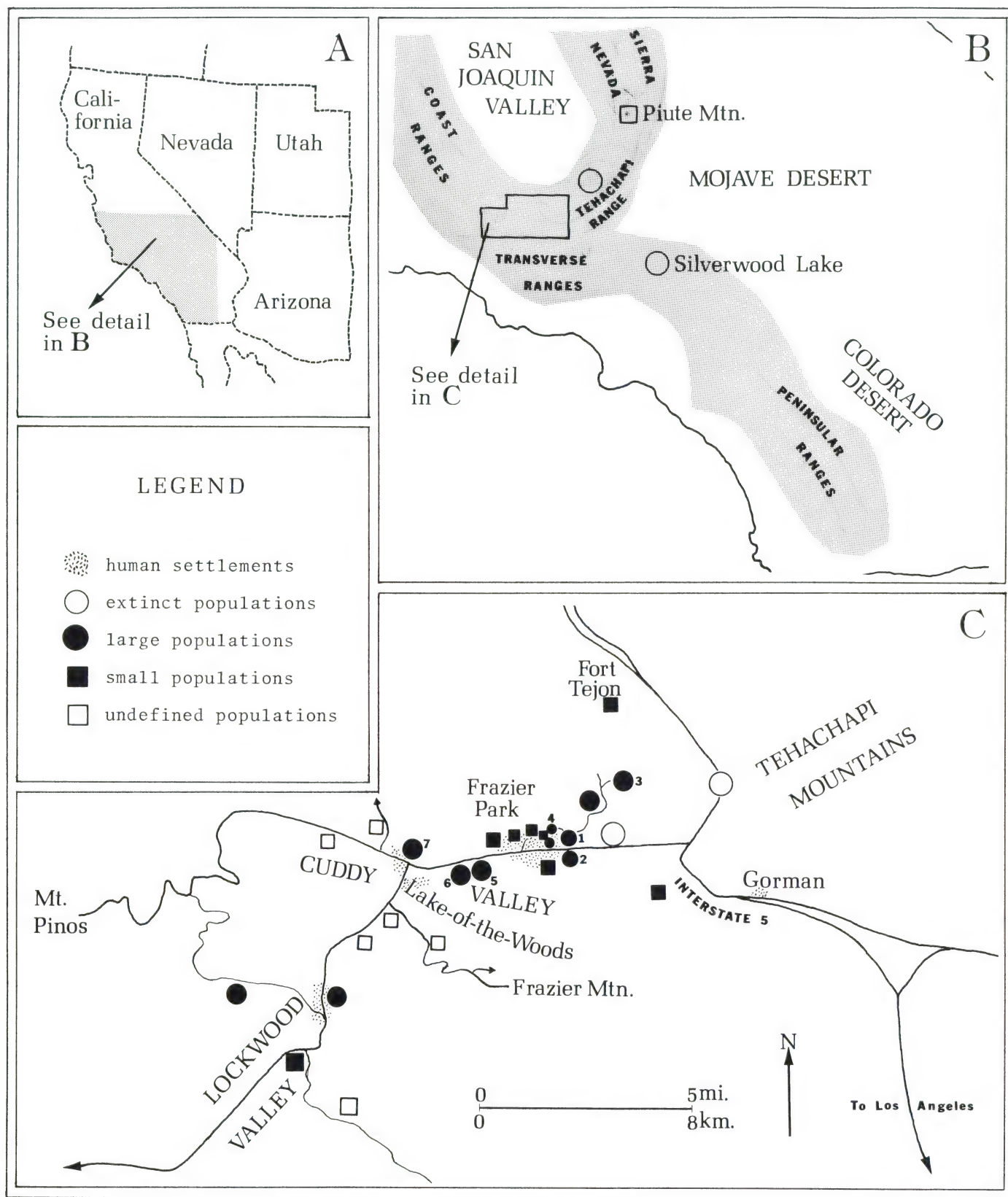


Figure 2: Range and distribution of the Bright Blue Copper. A and B. Southern California, with peripheral colony sites indicated. C. Detail of the center of distribution in the Mt. Pinos area, with colony sites indicated. In C, varying size of symbols for butterfly populations is in no way related to the size of the colony, but is due to map scale.

ABUNDANCE: The Bright Blue Copper occurs in scattered and fairly well defined populations; less than 30 are known. The butterfly is generally scarce within its range, although it may be locally common. It is "rarely represented in collections" (Emmel & Emmel, 1973).

ELEVATIONAL OCCURRENCE OF POPULATIONS: Thirty-one populations, including extinct ones, were considered. Four populations are known between 915-1220 meters (3000-4000 feet); 13 populations between 1221-1525 meters (4001-5000 feet); 11 populations between 1526-1830 meters (5001-6000 feet); and 3 between 1831-2135 meters (6001-7000 feet). The mean elevation is 1496 meters (4916 feet).

KEY POPULATIONS: By far the greatest concentration of populations is in Cuddy Valley (Fig. 2C). The two largest populations in areal size are numbers 1 and 2. Other important populations (in terms of population size) are number 3 in O'Neil Canyon; number 4 off Nat. Forest Rd. 9N01; number 5 at Cuddy Creek; number 6 at Cuddy Creek; and number 7 at Lake-of-the-Woods.

FUTURE THREATS TO POPULATIONS: Since populations tend to be located in valleys rather than on steep hillsides, they are particularly vulnerable to human activities. Several populations are located within or directly adjacent to the community of Frazier Park, and at the present rate of development, these are likely to be destroyed in the future. Mountain cabin resorts could threaten populations in other areas. Probably the greatest large-scale habitat destruction arises from the conversion of sagebrush to pasture land. This has already extensively happened in upper Cuddy Valley. This region lies about 129-161 kilometers (80-100 miles) north of the Los Angeles metropolis, and its smog-free, rather mild climate is attracting new residents in ever-increasing numbers, including some who daily commute to Los Angeles.

Bright Blue Copper Habitat

GENERAL HABITAT AND TOPOGRAPHY: Populations are nearly always located in montane valleys, rarely on hill slopes. They usually occur in open brushy vegetation (Sagebrush Scrub of Munz, 1974), sometimes with trees, principally Pinyon Pine (*Pinus monophylla* Torr. & Frem.) or Canyon Oak (*Quercus chrysolepis* Liebm.). They rarely are found in forest clearings, in contrast to the nominate subspecies of this butterfly. Populations are always located on well drained soils in areas with adequate moisture; the Copper is almost never found on south-facing or other arid slopes. Many populations are located in or adjacent to dry, gravelly washes or gullies.

PLANT COMPOSITION OF THE HABITAT: At the Bright Blue Copper populations visited, the following three plants were generally found to be most abundant: Common Buckwheat (*Eriogonum fasciculatum* Benth., ssp. *polifolium* (Benth.) Stokes, Fig. 4C), Great Basin Sage (*Artemisia tridentata* Nutt., Fig. 3A), and Rabbitbrush (*Chrysothamnus nauseosus* (Pall.) Britton, Fig. 3B). A fourth species, Yerba Santa (*Eriodictyon crassifolium* Benth.) was the dominant plant at one population site, but was not among the three most abundant species at any other sites examined. Yucca (*Yucca whipplei* Torr.) and Mormon Tea (*Ephedra* sp.) were found in very low numbers at several population sites.

LARVAL HOSTPLANTS: Three species of wild buckwheat (Polygonaceae) are known to utilized: Heermann's Buckwheat (*Eriogonum heermannii* Dur. & Hilg., Fig. 4A), Sulphur-flowering Buckwheat (*E. umbellatum* ssp. *munzii* (Reveal)

Thorne, Fig. 4B), and Common Buckwheat, Fig. 4C). Copper populations extending over the greatest area used the most widely distributed and abundant of the three, *E. fasciculatum*. In contrast, Copper populations occurring in the greatest density utilized *E. heermannii* -- indeed, eggs were preferentially laid on this species, even when other buckwheat hostplants were present. Nude Buckwheat (*E. nudum* Dougl., Fig. 4D) also was found at population sites, but was not used as a host. Buckwheats functioning as hostplants were bushy in growth with rather small leaves, whereas the non-hostplant species were not bushy, but had a rosette of large succulent leaves growing close to the ground, and a flower stalk bearing a single flower or rather small clusters.

Life History

The small, white, sculptured eggs (to be described elsewhere) are nearly always placed on the ventral leaf surfaces, remaining dormant until the following spring, probably until sometime in March or April. The green, slug-like larvae generally feed on the ventral leaf surfaces, skeletonizing one side of the leaf, as do many other lycaenid larvae. Older larvae may eat entire young leaves. Pupation is on the ventral leaf surface. Adults begin emerging in late June, the peak male emergence preceding that of the females. Only a few females remain to mark the population site by early August.

Adult Behavior

Males avidly perch. Perching and roosting of both sexes is preferentially on Great Basin Sage, when this species is present, although other plants, primarily Rabbitbrush, may also be used (Fig. 3).

Some adults moved very little within the population site, others a great deal. Virtually no movement away from the site was detected in 1975 or 1976. Male movement appears to vary with the location of adults in the population. Individuals found farther from the population center are less likely to have encounters with other males (males are "territorial" and appear to move less). The presence of females is a better indicator of the breeding site than is male presence, since males tend to be encountered also in the less suitable surrounding habitat.

Population Size and Density

A study of population size was conducted at one site in 1975, using a mark-release-recapture technique modified from that

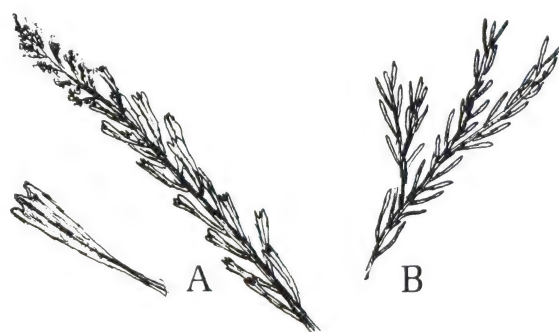


Figure 3: Adult perching substrates. A. Great Basin Sage (*Artemisia tridentata* Nutt.), with enlarged leaf at left. B. Rabbitbrush (*Chrysothamnus nauseosus* (Pall.) Britton).

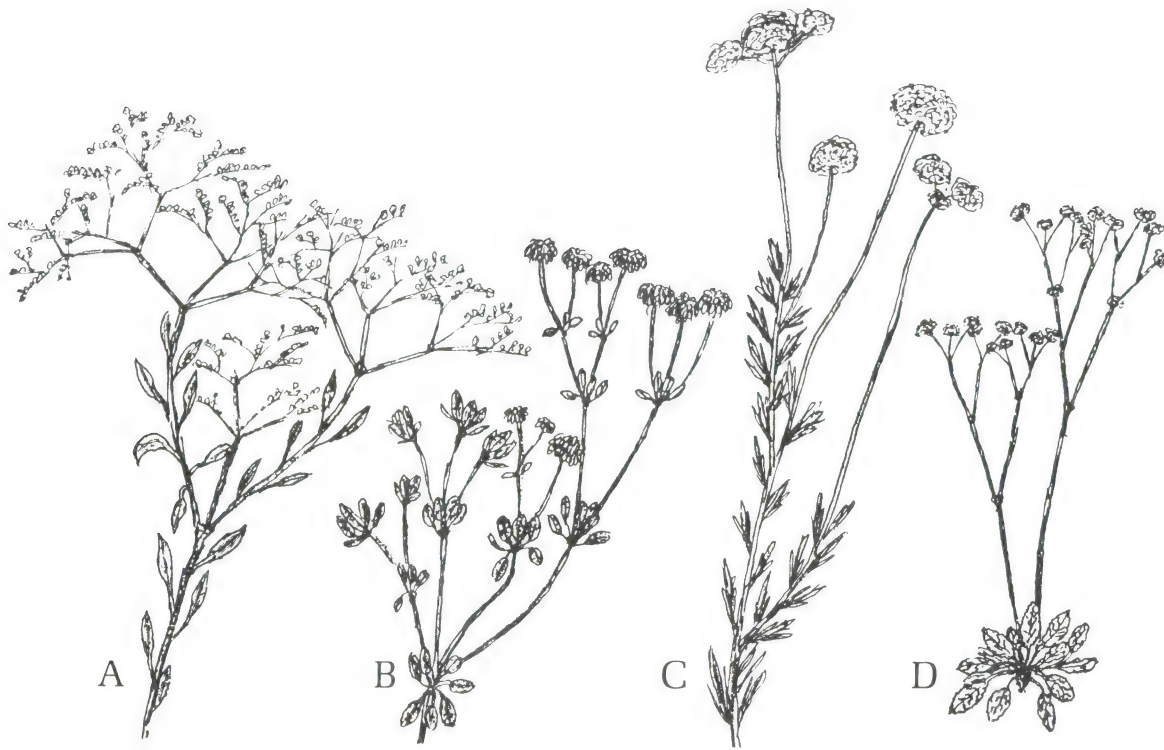


Figure 4: Buckwheats. A. Heermann's Buckwheat (*Eriogonum heermannii* Dur. & Hilg.). B. Sulphur-flowering Buckwheat (*E. umbellatum* ssp. *munzii* (Reveal) Thorne). C. Common Buckwheat (*E. fasciculatum* ssp. *polifolium* (Benth.) Stokes). D. Nude Buckwheat (*E. nudum* Dougl.).

described in Ehrlich & Davidson (1960). Data were analyzed using the stochastic model of Jolly (1966). At peak flight the population numbered 290 individuals. A similar study conducted in 1976 showed that the same population numbered only 135 individuals at peak. This decrease in population size appears to be correlated with a decrease in seasonal precipitation. Maximum density at this site in 1976 was one butterfly per every 24 square meters (28 square yards). The favorable habitat there was delimited and surrounded by unfavorable habitat, making an accurate density calculation possible.

Important Known Factors Limiting or Influencing Population Location

HOSTPLANTS: Hostplant distribution is usually scattered and localized within the range of the butterfly, which in turn dictates the location of populations. Density and quality of the hostplant at each site also determine presence or absence of the butterfly.

NECTAR SOURCES: The larval hostplant *E. fasciculatum* is preferred for nectaring purposes. This blooms only once per year, at the time of adult emergence. Non-buckwheat nectar sources have been recorded, but almost always at the beginning or end of the flight season, when sufficient amounts of preferred nectar were probably unavailable.

ELEVATION: Cold temperatures (encountered at higher elevations in southern California) have been found to break egg dormancy. Although diapause is apparently broken to a limited extent in the absence of chilling, the cold, winter, mountain temperatures prevent hatching even after dormancy is actually broken. The eggs hatch rather synchronously in early spring

when temperatures become sufficiently warm for embryonic development to occur. This synchronized hatching corresponds with the initiation of new growth of the hostplant; leaves can then be immediately fed upon by the newly hatched larvae.

PERCHING SUBSTRATES: In all but two known cases, populations were located in areas with heavy brush (primarily Rabbitbrush or Great Basin Sage). It is conceivable that the taller surrounding brush or trees exert a shading effect on the hostplant, inhibiting leaf dessication that would be detrimental to the larvae. The butterflies preferentially perch and roost on Great Basin Sage, probably because the adults are much better camouflaged on this plant than on Rabbitbrush and other available substrates. This may result in reduced predation (bird-pecked adults have been found). Thus, adult mortality may be lower at sites where the preferred perching substrate is common.

TOPOGRAPHIC FEATURES: None were found which directly affected the butterfly or which limit its distribution.

HIGHWAYS: The killing of adult butterflies by passing autos does not appear to exert adverse effects on the continued healthy survival of a population. The Lake-of-the-Woods population (number 7) is located on a steep hillside, adjacent to a highway. Butterflies do fly out over the road, particularly early in the season, but this situation has existed for many years, and the population remains large and healthy.

Recommendations for Habitat and Population Management

The following recommendations are made, based upon data obtained from population sites during the course of the study, and compared with similar sites not inhabited by the Copper. The

recommendations relate to habitat modifications which should result in maximum Bright Blue Copper population density.

(1) Presence of Heermann's Buckwheat as the primary larval hostplant, making up from 5 to 20 percent of the total vegetative ground cover at the site, is necessary. Higher plant densities would almost certainly give rise to increased butterfly populations, but the preferred buckwheat nectar source would also have to occur in greater density to compensate for the resulting larger adult populations.

(2) Presence of the preferred nectar source, Common Buckwheat, is necessary. This species should comprise about 5 to 15 percent of the total vegetative cover of the site.

(3) Alternate nectar sources, e.g., Deerweed (*Lotus scoparius* (Nutt.) Ottley) for early-emerging adults or *Encelia* sp. for late-emerging and end-of-season females, could be planted in low densities (probably less than 5 percent of the ground cover) in an effort to reduce mortality at either end of the adult flight season. This mortality may not be very important, particularly for early-emerging males.

(4) Presence of Great Basin Sage as the preferred perching substrate is important. Best height for plants would probably be in the range of 79 to 127 centimeters (31 to 50 inches). This plant should comprise about 15 to 20 percent of the total vegetative ground cover of the site.

(5) Trampling of the site should be minimized. While trampling does not significantly affect the individual plants used by the butterfly for nectar, egg-laying, or perching (because they are usually too tall to "trample"), it could have negative long-term implications for the population if the younger and lower-growing plants, important for continued survival of future generations of the butterfly as the older plants die, are damaged or destroyed.

(6) The smallest known area of habitat supporting a Copper population was 720 square meters (875 square feet) in size; this was in the middle of Frazier Park. Healthy populations were found to occupy habitats ranging from 1000 square meters (1200 square feet) to 1638 square meters (2000 square feet) in area. Habitat patches smaller than these could probably not support a Copper population, since significant dispersive loss was even found at the 720 square meter site. This small population will be monitored in the future to see if it can continue to survive in such a small area.

(7) Adult butterflies were never observed to fly through unsuitable habitat, such as a Pinyon Pine or oak woodland. Such a "buffer" might be established to minimize adult dispersal. It appears that populations located in a gradually changing environment tend to be more diffuse, with adults found farther from optimum habitat, than in those populations surrounded by woodlands.

(8) Larval hostplant quality appears to be of extreme importance, especially in the case of Common Buckwheat. This buckwheat is the least suitable of the three known larval hostplants, judging from its leaf size and butterfly oviposition preferences. Leaves of plants growing at locations with insufficient moisture, particularly on south-facing slopes, apparently are too desiccated to permit larval development (this is being quantified). Suitable plants were usually found growing in dry washes. Such plants probably receive adequate moisture from runoff as well as from direct precipitation during both wet and dry years, which would probably result in relatively stable butterfly populations from year to year. Both Heermann's Buckwheat and Sulphur-flowering Buckwheat have larger, more

succulent leaves than Common Buckwheat, and larval survival on these species may not be as greatly affected, indirectly, by moisture fluctuations. Leaf spacing on Heermann's Buckwheat is more regular, and the leaves closer together than on Sulphur-flowering Buckwheat, where the leaves occur in clusters, each cluster rather isolated from the next. The larvae can probably move more readily from leaf to leaf on Heermann's Buckwheat, resulting in greater survival to the adult stage. Indeed, populations are much more dense at sites with Heermann's Buckwheat than at sites where Sulphur-flowering Buckwheat is present. Physiological differences in the three buckweats, which might affect larval survival, have not been investigated.

Present Management Needs

Artificial habitat maintenance at population sites is unwarranted at the present time. The butterfly is quite rare and localized, but probably should not be considered threatened or endangered. Planting of the preferred larval hostplant, Heermann's Buckwheat, if possible, would probably enhance the size of any existing Bright Blue Copper population, particularly those where this buckwheat is presently absent.

If habitat disruption continues at the present rate, the healthy existence of the Bright Blue Copper will eventually be threatened. The United States Forest Service should act to insure the preservation of habitat for known populations occurring on federal lands. Unfortunately, many key populations inhabit privately owned property where future habitat disruption is fairly likely; this includes the largest population of which I am aware.

Habitat management would insure maximum butterfly density at remaining sites. It is doubtful that an attempt to develop new habitat would be very successful, since it is highly probable that some of the native plants, particularly those restricted in distribution (such as the preferred hostplant), may have specific edaphic and climatic requirements that limit their distribution to certain sites. Habitat management would probably have greater success in already existing favorable habitats, so that the remaining habitat could be used more efficiently for the butterfly.

Discussion

A workable and detailed set of habitat management recommendations for populations of any organism is impossible to conceive unless one has a thorough understanding of the relationships of that organism with its environment. This knowledge cannot be gained without an expenditure of both time and money. This study has been no exception. Such a task, then, is perhaps best relegated to the well funded student or professional lepidopterist, who can devote a large block of time to in-depth study. Time and money limitations unfortunately almost insure that management recommendations will only infrequently be developed, even though they would be invaluable for many rare, threatened, and endangered butterflies.

A multidisciplinary approach must be used to thoroughly study the relationships between butterfly and habitat. Butterfly distribution may be a reflection of vegetational distribution. Vegetational distribution, in turn, may be influenced or governed by climate, soil, or topography. Thus, it is invaluable to be proficient in vegetational, geological, and meteorological analyses, as well as in behavioral and other biological analyses, in order to adequately explain why a butterfly occurs in one place and not in another. It is always tempting to explain the distribution of a butterfly on the basis of larval hostplant

distribution or general habitat, but such speculation is simplistic; a complex of factors is more likely involved, coupled with biogeographic limitations.

Management recommendations are of little value unless they can be shown to work. But unless the organism in question is gravely endangered, there will be little incentive to actually test the recommendations. Data obtained on the habitat of the butterfly can be readily used, however, in locating potentially favorable sites for attempting artificial colonization. Butterflies such as the Bright Blue Copper, which are quite localized and not very dispersive, are slow to reach and colonize nearby favorable habitats which may have evolved in the meantime. Even if there is a natural colonization, there is a good chance it will be unsuccessful. Many unsuccessful natural "attempts" may be made before successful colonization is achieved. Destruction of habitat within an organism's range may further minimize the likelihood of favorable, but as yet uncolonized habitat being reached by the potential colonizing species. Hence, artificial colonization attempts, if within the normal range of the butterfly, can be legitimate, and of great benefit to rare and localized organisms.

It should be emphasized that an indiscriminate, unsophisticated approach to artificial introduction is probably a waste of time and effort; such attempts would probably be unsuccessful unless the presence or absence of the butterfly to be introduced depended only upon the presence or absence of its foodplant, an extremely unlikely possibility. There is sufficient information on the ties of the Bright Blue Copper to its environment to insure that introduction attempts would not simply involve speculation and guessing. Granted, other important but as yet undiscovered factors may limit the ability of the butterfly to survive in what appears to be favorable habitat. Even so, attempted introductions at this stage are very valuable tests of those habitat components thus far identified as requisite for the occurrence of the butterfly and its survival through many generations. If initial attempts to colonize favorable habitats are successful, present knowledge is, for the moment, probably adequate to explain the occurrence of the butterfly in specific locations within its overall range. If attempts are unsuccessful, and the site of introduction fits all the postulated criteria for habitat suitability, then additional research is obviously in order.

During 1976, I located several potentially suitable sites for the Bright Blue Copper in the Tehachapi Mountains. Since the butterfly is now apparently extinct from this region (a conclusion based on unsuccessful searches for it in 1974, 1975, and 1976), there is virtually no chance of these sites being colonized naturally. Thus, a colonization attempt was made in 1976 by releasing adults at a well defined patch of generally suitable habitat. The results of this first attempt will not be known until 1977. Hopefully, additional attempts can be made at other even more suitable sites, by introducing eggs or larvae instead of adults to eliminate the possibility of adults dispersing immediately after release, without laying any eggs. If these attempts are successful, then the research will have been worthwhile.

Any scheme involving habitat modification for the benefit of a single organism is open to criticism. There are important questions which must be considered: Is the organism declining naturally, rather than as a result of human impact on it or its habitat? Is the proposed habitat modification permanent or temporary in its effects? Is it ethical or legitimate to modify a habitat consisting of many species for the benefit of just one? Is it ethical to introduce organisms, either plants or animals, to sites

where they were previously absent? We must resolve these questions, both in a general and in a specific way. For example, is it proper to try to prevent any natural extinctions? If so, should the natural extinction of the Bright Blue Copper be averted? In the following paragraphs I deal with the above questions on both levels.

Should Natural Extinctions Be Averted?

This is a philosophical question, which will never have a universally agreed-upon answer. My view is that they should not, even in the interest of maintaining diversity. By manipulating the environment in an unnatural way to prevent the natural extinction of an organism, we are tampering with nature and altering natural events to nearly as great a degree as humans often do in bringing about the unnatural extinction of other organisms. Such habitat manipulation must necessarily continue indefinitely, in order to prevent a natural decline. Are we willing and able to spend time, money, and effort which could alternately be used to halt an unnatural extinction, in our efforts to prevent a natural occurrence? There is obviously a need for priorities in endangered organism research and population management, particularly in view of the rather limited time and money resources available for such work; the prevention of natural extinctions should be of lower priority than the prevention of human-induced extinctions.

Is the Bright Blue Copper naturally declining? If the apparent natural sudden decline and extinction of the Atossa Fritillary (*Speyeria adiastrata atossa* (Edwards)) (Orsak, 1974) within the Bright Blue Copper range is any indication, no. The only Bright Blue Copper population extinction known which could conceivably be attributed to natural causes is the Antelope Canyon population in the Tehachapi Mountains. The other population extinctions are easily attributed to severe habitat destruction brought about by human activities. The correlation noticed between population and precipitation fluctuation at one site during 1975 and 1976 suggests that continued drought could possibly result in the natural decline and possible elimination of remaining populations. The immediate and primary cause of population extinction up to this time, however, is human alteration and destruction of Bright Blue Copper habitat.

Should Any Habitat Modification That Is Not Permanent Be Attempted?

Of course, we must first ask whether it is legitimate to modify the habitat at all. In Great Britain, the general feeling apparently is that such modification is legitimate, even if it must be permanent. A case in point is the Large Copper at Woodwalton Fen. The hostplant of the butterfly, *Rumex hydrolapathum* Huds., may be naturally displaced by other plants with time, and hence some artificial maintenance is necessary at the one British population site. In the United States, there does not seem to be much expressed opinion regarding endangered invertebrates. If habitat modification on a once-only or short-term basis can bring about enhancement of remaining populations to the point where management practices are no longer necessary, then such practices are probably well worth the time and money. On the other hand, it is inconceivable that any habitat management scheme could continue on a truly permanent basis, particularly in view of the time, money, and long-term dedication involved. It is not likely that society would condone the high costs involved, particularly for one rather small and poorly publicized butterfly.

Is the Habitat Modification Proposed for the Bright Blue Copper of a Temporary or Permanent Nature?

The answer depends upon the ability of plants introduced or artificially increased in abundance to survive and reproduce. Will they maintain themselves in a modified state? The limited distribution of Heermann's Buckwheat (and of other plants in the Bright Blue Copper habitat) might be due to an historic restriction, perhaps coupled with poor seed dispersibility; an ongoing natural decline in numbers; or a narrow and specific range of environmental tolerances. Should the first possibility be the principal explanation for the plants' distributions, there would be a good chance of successful plant introductions to other Bright Blue Copper population sites, indeed, even the possible "creation" of favorable habitat. If either the second or the third possibility explains the distributions of these plants, successful introductions to new sites are unlikely. Unfortunately, there is simply not much known about factors actually limiting the distributions of plants important to the Bright Blue Copper. This further emphasizes my earlier point concerning the value and necessity of multi-disciplinary studies in wildlife management.

Is It Ethical or Legitimate To Modify a Habitat Supporting Many Species for the Benefit of One?

A value judgment is necessary here -- is it worth the potential risk of decimating or destroying populations of other organisms in order to enhance the population of one? Such a question cannot possibly be answered with a simple "yes" or "no." Instead, one must take into account the distribution and abundance of the organism that will profit from the proposed habitat modification, contrasting these data with the distribution and abundance for each of the many, many other organisms that would be affected by the habitat change in either a positive or negative manner.

How Would the Habitat Management Recommendations Proposed to Enhance Bright Blue Copper Populations Affect Other Sympatric Organisms?

Without knowing which organisms are present, an accurate impact assessment is, of course, impossible. However, the proposals given in this paper are in no way intended for widespread implementation, nor do they entail major alteration of habitat in most cases. Those plant species recommended for introduction are native, and most probably could be found growing in the vicinity of the introduction site. Recommendations pertaining to maximum ground cover for a given species usually entail increasing the density of a plant already present. Obviously, changes in the local abundance of organisms dependent on such plants will occur, but the fact that most of these plants are widespread throughout the region, if not throughout California (except for Heermann's Buckwheat -- its numbers would be definitely increased under the habitat modification recommendations), and that any proposed change would be localized, leads to the conclusion that there would be no significant detrimental effects on any other organism.

Is It Ethical To Introduce Any Organism into a Site Where It Did Not Previously Occur?

I can answer this question in part by emphasizing that I in no way advocate or approve of the introduction of any organism outside of its normal range, unless this can be achieved through

the format of a well controlled experiment, having no long-term adverse effects, by a qualified scientist. Of course, the release and establishment of an organism outside of its normal range presents potential problems which must be confronted prior to the introduction. The biggest of these is that such an organism, if released from native population regulation factors such as parasites, predators, pathogens, and climatic factors, may rapidly build up and displace native species. To support this, I need only mention the weedy nature of the introduced Monterey Pine (*Pinus radiata* Don.) in Australia (a species native to a very small coastal region in California), or the majority of United States agricultural insect pests, which were accidentally introduced from other regions. Of course, not all introduced organisms would have such disastrous implications, particularly if the introduction occurred just outside the normal range of that organism. Introductions to new sites within the normal range most likely do not pose unnatural problems, particularly if the site is one which the organisms might naturally colonize in time.

Some of the problems and questions involved in saving any declining organism and in preventing the destruction of stable ecosystems lie in our tendency to maintain present conditions. Natural extinctions have always occurred and always will. Yet, it is understandably difficult to observe the decline and extinction of any organism, whether caused by natural or unnatural means. Likewise, it is hard to witness, without some chagrin, the establishment of an exotic plant which spreads, outcompeting and eliminating the native vegetation. Even so, such introductions can occur and have occurred through natural dispersal in the past, especially on islands, with a probable resultant vegetational catastrophe, until the balance between the species was, in time, restored. Oftentimes, then, human actions resemble natural events, and it is difficult to take a stand against all extinctions or against the introduction, whether natural or artificial, of any non-native organism. New species are continually evolving, and the balance of nature is restored after each natural micro-catastrophe. The difference between natural and human-induced extinctions (a very important one) is that humans have brought about the extinction of many more organisms than have evolved in a given time, and the continual introduction of exotic organisms often occurs with such rapid succession that there is constant imbalance.

In light of the above discussion, a reexamination of the Bright Blue Copper recommendations in this paper is in order. The butterfly is currently neither endangered nor threatened. Hence, artificial habitat modification is presently in no way necessary to insure survival of the butterfly. Nevertheless, the proposals have been made in view of the likelihood that this very rare and localized invertebrate could become threatened in the foreseeable future. Such a population decline would not result from collectors or their activities, but rather from habitat destruction and alteration of the remaining valley floor native vegetation, from the growth of already-existing human communities, and/or from the conversion of the native scrubby vegetation into pasture land. The fact that so many of the approximately 30 known populations are located on private property is a forewarning that attempts to preserve most populations will be both difficult and costly.

Habitat modification suggestions proposed here range from very minor alterations (introduction of preferred adult and larval hostplants to population sites where only the less preferred adult and larval hostplant presently grow) to the less minor manipulation of plant cover and density at a particular site. The objective

in any type of habitat modification is to enhance existing populations, particularly those on federal lands which are not likely to be destroyed in the near future. Major habitat modification for the benefit of the Copper would be necessary only in the event that remaining populations were so few in number that drastic measures to enhance or establish populations would be in order. Any habitat or population management which is not permanent (i.e., there is a gradual return to the original condition) can be nothing other than a temporary measure. The permanent solution to human-induced population declines is, of course, the acquisition of adequate habitat, but this is not likely to occur, particularly if it would benefit only one very rare invertebrate. The larger the habitat reserve, the less likely that habitat management will be necessary.

The proposals outlined in this paper for Bright Blue Copper habitat management may appear premature in view of the not-yet-threatened status of this localized butterfly. Yet, I feel it wise to develop these recommendations since the continuing destruction of populations is probable. Likewise, the proposals and other data form a useful tool for locating and assessing potentially favorable habitats within the range of the butterfly, at which population introductions might be attempted. The ultimate results of such attempts will determine the accuracy and completeness of the habitat characterization. Finally, the characterization and qualification of preferred habitat for a butterfly is one step beyond the present tendency toward generalization and simplification. By closely examining the ties between butterfly and environment, and carrying out experiments to determine how many changes in various components of the habitat affect populations of that organism, we should better be able to explain its rarity.

Acknowledgements

The financial support of the Naturalists' Club of Laguna Hills,

California, during the 1975 studies, and of the Eppley Foundation for Research of New York, New York, during the 1976 studies, is gratefully acknowledged; this research could not have otherwise been conducted. A number of southern California lepidopterists provided distributional information or aided in discovering additional populations, including Jim Brock, William Klein, Ron Vanderhoff, Chris Henne, John Emmel, and Chuck Sekerman. Robert Dirig and John F. Cryan made valuable suggestions during the preparation of this paper.

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A Preliminary Scan of Rare and Endangered Nearctic Moths

Sidney A. Hessel*

Abstract

Information about rare and endangered Nearctic moths from the author's experience and from questionnaires answered by 22 contributors to the past two "Season's Summaries" (*News of the Lepidopterists' Society*) is presented as a preliminary, informal report. Information is available only for the larger moths: Saturniidae, Sphingidae, and *Catocala*. Human alterations were blamed for most local disappearances of species over the past 30 years, with clearing, drainage, agriculture, chemicals, artificial lights, and vehicular traffic suggested as causes. *Catocala pretiosa* and *Euproserpinus euterpe* may be extinct. Locally extinct or rare over large areas are *Catocala hippolyta*, *C. nebulosa*, *C. piatrix dionyza*, *Ceratomia undulosa form engeli*, *Hyalophora columbia*, *Manduca jasminearum*, *Palada scarletina*, *Sphinx luscitiosa*, and many northeastern saturniids. *Anisota finlaysoni* may become extinct as single large oaks, its foodplant, disappear. *Callosamia promethea* disappears locally for years, but then reappears; this fluctuation may be natural.

Introduction

The literature on the subject of this symposium treats mainly the butterflies. A larger number of people collect and study butterflies than moths, probably because butterflies are more conspicuous and have more esthetic appeal; butterflies are also easier to observe and collect in the field and prepare and store for study. As moths are equally pertinent to the subject, however, it is the purpose of this presentation to discuss them as a group with broad treatment geographically and taxonomically. Some moths have not been altogether overlooked in applicable studies oriented to limited, specialized habitats, in the past.

Methods

To obtain information on rare and endangered Nearctic moths, the cooperation of contributors to the past two "Season's Summaries" (published in *News of the Lepidopterists' Society*) was solicited by a questionnaire. Lepidopterists from the Pacific States to the Atlantic and from Canada to the Gulf of Mexico responded to my inquiry. This impressive geographic representation boils down to 22 collaborators, some of whom, however, confined their specific observations to butterflies or presented only general statements overlooking the precise questions I asked. This report is concerned only with moths, but the butterfly information will be passed on to other workers. The survey was not conceived in the expectation of producing crisp, causal findings of broad application. I hope this short report will encourage further carefully documented observations for relevant species. At least some information assaying present populations, sparse and informal as it may be, is here being made available for future studies.

The great numbers of moth species, even uncommon ones, discourage record-keeping. Few collectors have the opportunity for daily observations, especially of light trap catches. In my own case, the operation of a Robinson trap with a 125-watt mercury vapor lamp throughout the night at the same site from late March through November each year afforded valid annual numerical comparisons for those species I recorded daily: Sphingidae, *Catocala*, *Papaipema*, and recently, Saturniidae. As I expected, the only moth species discussed by respondents to the survey belonged to the Saturniidae, Sphingidae, or *Catocala*, with one exception.

Shortcomings of the survey were the limited numbers of observers and of their observations, which precluded satisfactory geographic and temporal coverage for each species. One collaborator found that a species he had considered rare had been so only because he had sought it late in its flight season. It was pointed out by several people that there has long been an awareness of cyclical population fluctuation varying from two to three to over ten years between peaks, or even in the very appearance of the species. I wonder, however, if the term cyclical, so frequently applied to Lepidoptera populations, is valid. Its implication is of greater regularity and predicability than I believe has been evidenced. This, of course, does not invalidate the historical record of the extremes within which populations have been observed to fluctuate.

Factors Affecting the Decline of Moth Populations

Collaborators generally agreed that human influences have become ever more important during the last 30 years, and that beyond doubt they are the reason for the scarcity of many species and for the disappearance of others, particularly those of very limited habitats. This conclusion, of course, is irrefutable in instances of land clearing, swamp drainage, and probably, at times, grazing -- all of which utterly destroy the former biota. Other suggested influences, predictable yet more difficult to appraise for their impacts, included drought, pesticides, herbicides, chemical air and water pollution, radioactive fallout, highway and street lights, vehicular traffic, and overcollecting.

It is not the purpose of this report to discuss at length the values and liabilities of pesticides and herbicides, although some

*This was the first objective attempt to gather information on Nearctic moth conservation problems. Since he intended to carry it further, Mr. Hessel did not publish the results of his scan prior to his death (see *Atala* 2(2): 19). This paper was presented as part of the Symposium on Endangered and Extinct Lepidoptera held at the 25th Annual Meeting of the Lepidopterists' Society at San Antonio, Texas, in 1972. We felt that the report was of lasting value, containing much original information, and that it should be published. Charles L. Remington, who organized the San Antonio symposium, kindly made the manuscript available. We hope it will serve as a posthumous reminder of Mr. Hessel's deep concern for the welfare of our native moth fauna, and as a memorial to the initiative and foresight he brought to all of his devotions. At the time of writing, Mr. Hessel was Research Associate in Entomology at the Peabody Museum of Natural History, Yale University, New Haven, Connecticut, USA.

respondents did so. No comments of significance were received which did not echo the literature with which most of us are already saturated, except for one very interesting observation from James Mori. Involved professionally in the issue, he wrote:

It is not always the agricultural pest populations that have benefitted from the dependence on chemical overkill in agriculture. Let me cite two examples of non-agricultural populations that have experienced population booms because of pesticide applications.

In the Santa Maria area of California, the population of *Hyalophora euryalis* (Boisduval) has been at almost epidemic numbers on ornamental Brazilian Pepper Trees grown as windbreaks for vegetable crops, for at least seven years. This is an extremely high pesticide use area. The chemicals applied to the lettuce, celery, broccoli, strawberries, and beans also end up on the Pepper Trees. The pesticides are perhaps more lethal to the hymenopterous and dipterous parasites than to *euryalis*, and therefore the *euryalis* population may have derived a direct benefit from the application of pesticides.

In the Sacramento County tomato-growing regions, extremely high populations of *Attilides halesus* (Cramer) occur adjacent to the tomato fields that receive many airplane-applied pesticides. This is probably another case of the disruption of the natural parasite-predator populations in the area.

Pollutants, perhaps including radioactive fallout, were deemed to have some bearing on populations, depending on proximity of the population to the source of pollution and the threshold of tolerance to the pollutants involved. In the absence of sophisticated experimental investigation, the impact of pollution cannot be realistically evaluated.

Collecting was generally not considered dangerous to the survival of species, except for possible localized effects.

Possibly significant factors which I have not seen mentioned in the literature are highway and automobile lights, which can cause traffic mortality. If automobile radiators are examined in rural areas, they often produce numbers of dead moths which, when multiplied by a factor of traffic density, suggest considerable carnage. While living on Long Island, New York, during the construction of the Southern State Parkway through large, previously unaltered expanses of the Long Island Pine Barrens, I habitually collected with great success at the highway lights mounted high on heavy wooden poles. It was necessary to knock most of the specimens from the poles with a long fishing rod carried for that purpose. When this highway was first opened, traffic was very light, especially at night, and one could easily pull off onto the shoulder and collect. I did this for four or five years, during which time I became well aware of the progressive deterioration in the quality of collecting from season to season. By the time the "No Stopping Except For Emergency" signs appeared, I had long since abandoned my visits for lack of productivity. This was before extensive use of pesticides and the development of synthetic hydrocarbons. The highway still traverses impressive but shrinking stretches of the Long Island Pine Barrens.

Although automobile mortality is probably not a major factor influencing populations of rare species, I have even collected an *Erora laeta* (Edwards) run over by a car! I once counted an average of one Monarch Butterfly (*Danaus plexippus* (L.)) per mile lying on the highway, over a 40-mile stretch along the Pacific Coast Highway north of San Simeon, California. How many

more had been blown onto the road margins? Perhaps nocturnal auto traffic could be significant in suburbia, where at least limited vacant areas (appearing suitable to support some of the absent larger moths) still exist.

The disappearance of saturniids and some other large moths, especially in the Northeast, was widely noted by my correspondents. There can be no doubt of a general trend in this direction, despite one contributor's success in calling males with a reared female, even though he had been unable to find cocoons the previous winter. No "cyclical" explanation satisfactorily accounts for the catastrophic depletion of saturniids to the point of no captures of some species over the past dozen years in places which still appear to provide vast amounts of suitable habitats. Due to the abandonment of farming and the resultant encroachment of hardwoods into the fields, there is more "edge land" (normally favorable to many lepidopterans) in Litchfield County, Connecticut, than existed there at the time of the American Revolution. Nonetheless, there as elsewhere, certain conspicuous moths have declined remarkably.

Moth Species Which Have Declined in Abundance

Two North American moths appear to be extinct, or nearly so, at this time -- *Euproserpinus euterpe* H. Edwards (Sphingidae) and *Catocala pretiosa* Lintner (Noctuidae). Concerning the former, Hodges (1971) wrote: "*Euterpe* is one of the very rare species of sphingids that may no longer occur in southern California. To date only three specimens are known, and they were collected about 90 years ago." *C. pretiosa* turned up regularly in collections made prior to about 1912, but not since.** Furthermore, I am aware of no recent reports of northeastern populations of *Sphinx luscitiosa* Clemens or *Catocala nebulosa* W.H. Edwards. *S. luscitiosa* was always considered local in its distribution, but I was able to collect eggs and young larvae in large numbers on willows (*Salix* sp.) and aspens (*Populus* sp.) in the early 1930's in the environs of Roselle Park, New Jersey. *C. nebulosa* seems to have disappeared in the Northeast in the early 1930's.

Neither a species nor a subspecies, but interesting nonetheless in the context of extinction, is the melanic form *engeli* Chermock & Chermock of the sphingid *Ceratomia undulosa* (Walker). Not uncommon in the Pittsburgh, Pennsylvania area during the worst period of soft-coal pollution earlier in this century, it now seems to be totally missing from local samples, the population having assumed the non-melanic, paler grey coloration.

A few more members of the relatively conspicuous moth groups have clearly declined drastically in numbers in recent decades. Seven of these brought sufficient response from my respondents that I can summarize their situations here. I do not consider any of them to be in imminent danger of extinction, except locally:

The eastern sphingid *Manduca jasmineearum* (Guerin) was a regular arrival at my moth lights in Connecticut when I started collecting at this locality in 1952, and it remained so through 1955, some nights as many as a dozen individuals coming to the lights. I have taken none since that year. Others who have collected within the northeastern range of *M. jasmineearum* have reported similar experiences. One possible reason for the decline of this species is that it was unusually affected by the extremely heavy insecticide use in its territory (chiefly aerial spraying of DDT against Gypsy Moth (*Lymantria dispar* (L.)) infestation). A

**There have been several recent captures; see *Atala* 3: 14-15.

possible ray of hope came from one respondent, William Boscoe, who took seven specimens over a short period in 1971, in an area of eastern Pennsylvania which had yielded none during the previous four years. In its wilder haunts in the South, the moth may not have declined in numbers.

Hyalophora columbia (S. I. Smith), the northeastern, Larch-feeding saturniid, truly has become an extreme rarity during this century. Some populations have disappeared altogether through the logging or draining of Larch (*Larix laricina* (DuRoi) K. Koch) communities. Human alteration of the landscape may be firmly designated as the agency of local extinction in most instances of *H. columbia* depletion.

Anisota finlaysoni Riotte, a small citheronine, has only recently been distinguished and named (Riotte, 1969). In a letter the author explained that the moth is only known from around Belleville (Ontario), from a territory between Hamilton and St. Williams, and from a very few old records from Minnesota and Wisconsin. In the field, *A. finlaysoni* prefers single, old, oak trees, especially White Oak (*Quercus alba* L.). As that kind of tree becomes more and more scarce, there is a possibility that the species may be on the way out. However, there is also the possibility that it occurs in many more localities in the Midwest, without having yet been recognized.

Callosamia promethea (Drury) is one of the most challenging species to one interested in fluctuations in abundance. This saturniid is now apparently absent from many areas where it was extremely numerous in the past. However, it has undergone drastic reductions before, followed by great "booms" in abundance. Will it reappear soon in many of the areas where it is now "missing"?

Three noctuids which were once plentiful in localized colonies in southern California have now been eliminated or severely threatened, according to information supplied by Christopher

Henne. *Palada scarletina* J. B. Smith has largely withdrawn from the El Segundo dunes since 1966, due to development of the Los Angeles International Airport and surrounding urbanization. *Catocala hippolyta* Strecker was "at one time plentiful in all canyons with Black Cottonwood [*Populus trichocarpa* T. & G.] association, but is now rare, due to human developments." At least into the 1940's, *Catocala piatrix dionysa* H. Edwards occurred in abundance in a colony southwest of Covina in Los Angeles County. Henne interpreted the construction of a new freeway in the vicinity as the cause of its extinction there.

Conclusion

Without individual recognition at this time, I wish to thank all of those who responded to my appeal. In many cases they will receive further correspondence from me requesting elaboration of the information they have furnished. I expect also, under less hurried circumstances, to enlist the help of others not yet approached. This will be directed particularly to the Saturniidae, Sphingidae, and *Catocala*, in which groups interest is widespread. Hopefully, the number of reports and geographical coverage may thereby be sufficient to interpret the data on population changes in these groups with increased confidence.

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The Karner Blue Project: January 1973 to December 1976

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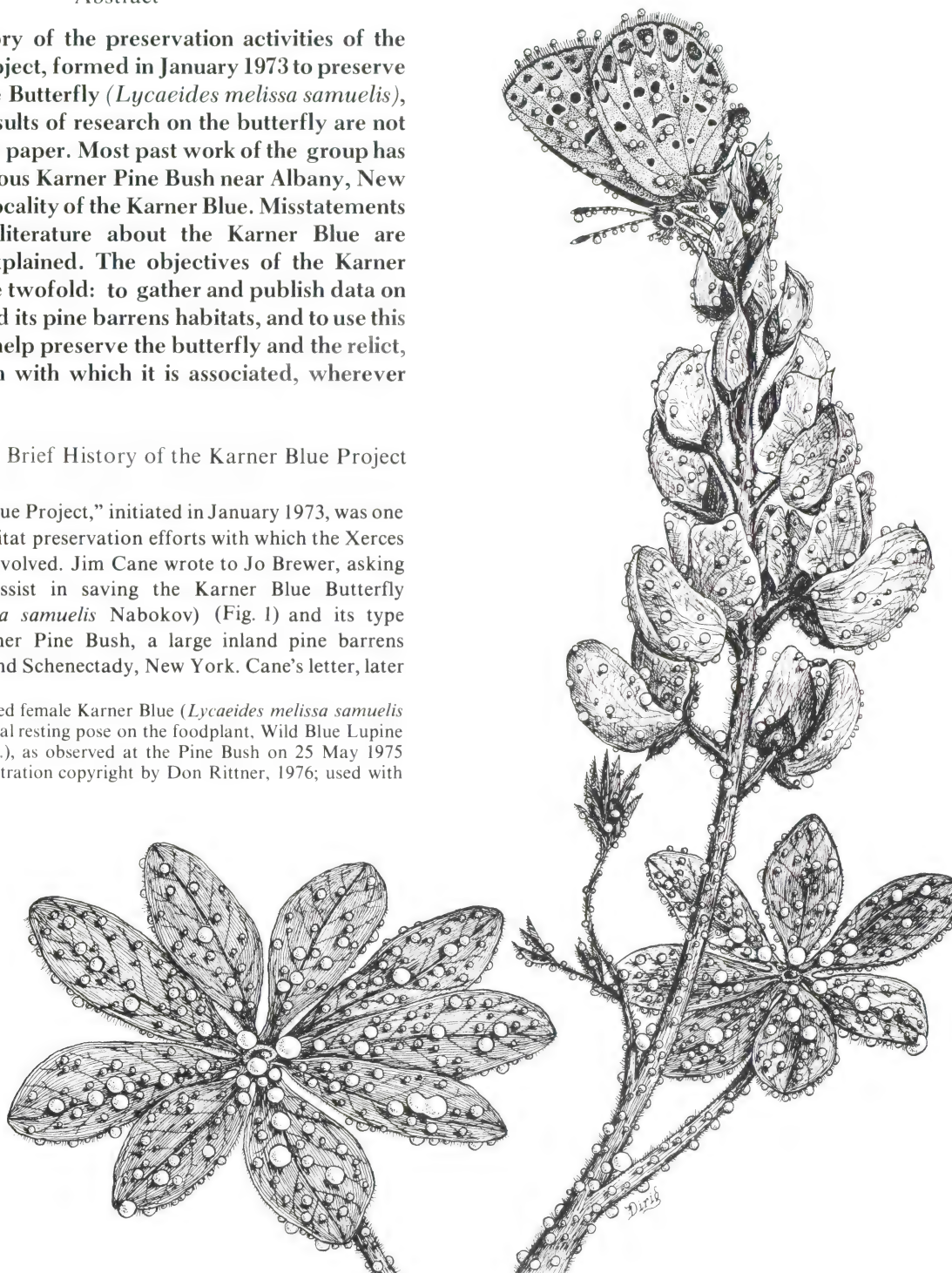
Abstract

A brief history of the preservation activities of the Karner Blue Project, formed in January 1973 to preserve the Karner Blue Butterfly (*Lycaeides melissa samuelis*), is presented; results of research on the butterfly are not discussed in this paper. Most past work of the group has been at the famous Karner Pine Bush near Albany, New York, the type locality of the Karner Blue. Misstatements in the recent literature about the Karner Blue are corrected or explained. The objectives of the Karner Blue Project are twofold: to gather and publish data on the butterfly and its pine barrens habitats, and to use this information to help preserve the butterfly and the relict, xeric vegetation with which it is associated, wherever possible.

Introduction: A Brief History of the Karner Blue Project

The "Karner Blue Project," initiated in January 1973, was one of the earliest habitat preservation efforts with which the Xerces Society became involved. Jim Cane wrote to Jo Brewer, asking the Society to assist in saving the Karner Blue Butterfly (*Lycaeides melissa samuelis* Nabokov) (Fig. 1) and its type locality, the Karner Pine Bush, a large inland pine barrens between Albany and Schenectady, New York. Cane's letter, later

Figure 1: Dew-covered female Karner Blue (*Lycaeides melissa samuelis* Nabokov) in nocturnal resting pose on the foodplant, Wild Blue Lupine (*Lupinus perennis* L.), as observed at the Pine Bush on 25 May 1975 by the authors. (Illustration copyright by Don Rittner, 1976; used with permission.)



published (Cane, 1973a), with its request for a popular article on the butterfly for Albany-area newspapers, was referred by Brewer to Robert Dirig. The requested article, summarizing the life history and distribution of the butterfly and mentioning its decline in the Albany area, appeared in March (Dirig, 1973a). In May, at Cane's invitation, both Brewer and Dirig spoke at a symposium on the Karner Blue, Pine Bush, and local preservation efforts, at the New York State Museum in Albany. Each separately visited the Pine Bush at this time, and found larvae of the butterfly which were reared to the imago. In June, a review of this meeting and an account of Brewer's field work appeared (Brewer, 1973), and in July a more detailed account of the meeting was published (Cane, 1973b). Three popular articles on the butterfly and Pine Bush were printed in early autumn (Breen, 1973; Cane, 1973c; Dirig, 1973c).

Throughout the following winter, Dirig corresponded with other lepidopterists and searched the literature to obtain distributional and life history data and information on the status of various populations of the butterfly. In April 1974, at the First Annual Meeting of the Xerces Society at Yale University, New Haven, Connecticut, he presented a detailed report on the Karner Blue situation. A 6-page leaflet on the butterfly and its habitat was published in late spring (Dirig, 1974).

In October 1974, studies of the Buck Moth (*Hemileuca maia* (Drury)) were initiated at the Pine Bush by Dirig and John F. Cryan. This large, beautiful, diurnal saturniid is very local, the Karner population is well known and one of the northernmost extant, and the species had been observed to be declining there for a number of years by Jan K. Krepa, a local lepidopterist. With the beginning of detailed field studies of Pine Bush Buck Moths, the Karner Blue Project broadened from its original emphasis on preserving the butterfly to include the preservation and study of the Buck Moth and all other biota of the Karner pine barrens. A botanical collection was also begun at this time.

In October, while in the field, we met Don Rittner, Albany City Archaeologist and Director of the Pine Bush Historic Preservation Project. In December, he invited us to speak at a meeting in Albany of conservationists interested in Pine Bush preservation. At this time we distributed a booklet on the Karner Blue, Buck Moth, and their Pine Bush habitat (Dirig & Cryan, 1974).

In mid-winter 1975, plans were announced by Albany-area officials to rezone the Pine Bush for development that spring. This caused much publicity in the local press and on radio and television, especially after the Karner Blue and several other butterflies were listed by the Office of Endangered Species for review of status as possibly endangered or threatened (Greenwalt, 1975). An article on Pine Bush Buck Moths appeared in March (Cryan & Dirig, 1975), and a second report on the Karner Blue situation was presented by Dirig at the Second Annual Meeting of the Xerces Society at Cornell University, Ithaca, New York, in April. On 5 May, the Albany Common Council held a public hearing on whether to rezone a large portion of the remaining Pine Bush for development. Five Xerces Society members -- Cane, Cryan, Dirig, Robert M. Pyle, and Frederick C. Schlauch -- testified in opposition to the rezonings; 34 other people representing a wide diversity of organizations also spoke against rezoning at this time (Dirig & Cryan, 1975b). At the hearing we distributed a revised edition of the booklet *Endangered Pine Bush Lepidoptera* (Dirig & Cryan, 1975a). In early summer, the Albany Common Council unanimously rejected the rezonings proposed by the developer.

In the meantime, we spent several weeks at Karner in May and July 1975, studying both broods of Karner Blues. Notes were made and photographs taken of the diurnal and nocturnal resting postures, courtship and mating of the butterfly, and egg placement in the wild. Adult nectar sources were recorded for both broods. The Pine Bush was canvassed to find out exactly where the butterfly occurred and its distribution there was mapped. Observations were made of the annual cycle of the one known larval foodplant of the Karner Blue, Wild Blue Lupine (*Lupinus perennis* L.) (Fig. 1). Herbarium specimens of the foodplant and other flora were collected, and a general Pine Bush insect collection begun. (Much of this information will be published separately.) A very brief resume of the summer's findings was presented by Dirig at the 26th Annual Meeting of the Lepidopterists' Society in Amherst, Massachusetts, in August. Further observations of Pine Bush Buck Moths were made in September and October 1975.

We revisited the Pine Bush in May and June 1976, observed the spring brood of Karner Blues, and collected additional plants. Much information on the Karner population, including the first published photographs of the life stages of the Karner Blue, appeared in a popular, 264-page book on the Pine Bush in June (Rittner, 1976b). The first, small, controlled burning experiment at the Pine Bush was performed on 29-30 April, and was described briefly in Rittner (1976c). To our knowledge, the Karner Blue does not inhabit this control-burned site. We continued field observations of Pine Bush Buck Moths in September and October, with the assistance of Anita and James G. Barbour, Walter A. Koenig, and Gerard Lemmo, and collected additional plants.

In October 1976, the New York State Department of Environmental Conservation ordered a halt to sand mining in the section of Pine Bush approximately 800 feet west of Route 155 and 200 feet north of Old State Road, within the Town of Guilderland. This was the precedential application of the New York State Mined Land Reclamation Act; sand mining was stopped on grounds that it caused irreversible and irreparable damage to the state's natural resources. The huge dune from which sand was being removed is believed to be the "Mount Brizo" mentioned in Bailey (1877). Peter J. R. Buttner, Dirig, Robert L. Miller, Rudolf Petersen, Rittner, and others testified in opposition to the mining at the ensuing hearing, and a decision is pending. Lowell Suring of the Department of Environmental Conservation also announced in December 1976 that the Karner Blue will be the first insect placed on the New York State list of Endangered Species early in 1977. Its listing is independent of our efforts, although evidently based largely on our publications.

Recent Published Errors and Inconsistencies about the Karner Blue

Since the initiation of the Karner Blue Project, a number of errors and inconsistencies have been published about the Karner Blue. We would like to correct or explain the major ones here.

Several misstatements about the present range, distribution, and status of the Karner Blue have been published. *L. m. samuelis* is presently known from about 50 localities in New Hampshire, Massachusetts, New York, Pennsylvania, Ohio, Michigan, Indiana, Illinois, Ontario (Shapiro, 1969); Wisconsin (Masters & Karpuleon, 1975); and Minnesota (Robert P. Dana, 1976, *in litt.*). Populations are apparently extinct in some reported localities, such as on northern Manhattan Island in New York

City (Alexander B. Klots, 1973, *in litt.*) and northern Illinois (Irwin & Downey, 1973). While the butterfly occurs in localized populations, it is usually very common where found. It is likely that additional populations may be discovered as lepidopterists find and explore new sand barrens or pine barrens supporting *L. perennis* in northeastern and north-central North America.

In view of the known range of the butterfly, it is not true that the Karner Blue "is now down to one final foothold, one last colony, located outside of Albany, in the Pine Bush area of Karner," or that its range once extended "from British Columbia to the Catskill Mountains" as was reported by Cane (1973a) and repeated from that source in a later publication (Pyle, 1973); nor is it true that "the Pine Bush represents the Karner Blue's last foothold on this planet" (Rittner, 1976a), or that the butterfly is "endemic" to the Pine Bush (MacRobert, 1975). In addition, the scarcity of the butterfly at the Karner Pine Bush has been exaggerated by Rittner (1976a) and by Dirig (1973a, 1973b, 1973c). Our early maps (Dirig & Cryan, 1974, 1975a, 1975b) show the locations of only a fraction of the colonies at the Pine Bush, although they do accurately represent the locus of the type population. The most recent detailed map (Dirig, 1976) represents the present known locations of the approximately 20 viable Karner Blue colonies at Karner. This local distributional data is based on four weeks of field work in the summer of 1975. (By a "colony" we mean a subpopulation of Karner Blues that restricts most of its activities to a specific area supporting Lupine.) A few more colonies will probably be found, although most of the seemingly suitable habitat at the Pine Bush has been thoroughly explored. We do not mean to imply that most colonies of the type population and several populations of the butterfly elsewhere are not imperilled by imminent development, but the butterfly still seems to occur in abundance where populations persist. However when its habitat and foodplant are destroyed, it will also perish.

Miller (1975) stated: "Quite possibly the Karner locality is one of the poorest places to seek the blue [Karner Blue], at least at this time. . . . The remaining populations of *L. samuelis* [sic] are viable and in no danger." These assertions are false. The Karner Blue population numbers several thousands of individuals at the Pine Bush. Thus this is still one of the best places to see the butterfly. It is the largest of the nine populations we have seen in eastern New York. Several other populations are as gravely endangered by impending development as the Pine Bush population, if not more so, due to their smaller size (in both numbers of individuals and area covered). Another imperilled population is the famous "Hessville," Indiana locality which, like Karner, lies on the outskirts of a sprawling metropolis, Chicago. The butterflies are found there between 11th Avenue and 15th Avenue, the E. J. and E. Railroad tracks, and Colfax Street in Gary, Indiana (Roderick R. Irwin, 1973, *in litt.*). William D. Winter, Jr. (personal communication) has reported another "fragile" population in Merrimack County, New Hampshire. Eight small populations we have seen in eastern New York could be very easily destroyed by an hour's bulldozing.

Miller (1975) went on to compare the proposed listing of the Karner Blue as "threatened" by the Office of Endangered Species (OES) as "analogous" to the listing of the American Alligator (*Alligator mississippiensis* (Daudin)) as an endangered species "in a decidedly emotional decision." The alligator, he said, has bred unmolested for a few years and has enjoyed such a population increase that in some areas it has become a distinct pest. . . . This species is now being proposed for declassifica-

tion throughout most of its range. . . . This dreary history of the alligator's classification as "endangered" merely demonstrates the fact that such emotional, rather than scientific, assessments of species' status should be avoided if at all possible.

However, we believe that the two situations are not analogous. The Karner Blue has not been listed as either endangered or threatened by the OES, only proposed for review of its status. Even if given the protection prescribed for a federally-designated Threatened or Endangered Species, it is very unlikely that such a local butterfly, which feeds as a larva only upon a native lupine, would increase rapidly to pest proportions. Had the butterfly been ruled endangered or threatened, Miller's remarks about an "emotional decision" might have been justified; the fact that it has not been, pending the gathering of further data, points to the caution with which the OES approaches decisions of this sort.

Brewer (1973) reported that she and Ivy LeMon found ova, ova shells, final instar larvae, and a female adult Karner Blue on and near Wild Blue Lupine along a power line right-of-way at the Karner Pine Bush on 11 May 1973. Subsequent rearing proved that the ova and ova shells were of the Frosted Elfin (*Incisalia irus* (Godart)), a sympatric Lupine-feeder (Jo Brewer, 1973, *in litt.*). The blue butterfly seen on that date was probably either an Eastern Tailed Blue (*Everes comyntas* (Godart)) or a Spring Azure Blue (*Celastrina argiolus* (L.)). Both species occur in large numbers throughout the Pine Bush and should have been on the wing at that time of year. Based on museum specimens, literature records, and our field work, the spring brood of Karner Blue seems consistently to begin flying at the Pine Bush on or a few days after 20 May. Males precede females in emergence by two or three days, so that individuals observed very early in the flight season would almost surely be males. The butterfly seen by Brewer and LeMon on 11 May 1973 was neither collected nor photographed. A very early Karner Blue record is, of course, possible.

Our booklet *Endangered Pine Bush Lepidoptera* (Dirig & Cryan, 1975a) has been incorrectly cited by Orsak [1976] and by Pyle (1976a, 1976b). This is apparently due to the address on the inside back cover. Please refer to our literature cited for the correct citation.

The following will clarify the confusion caused by statements in *Wings* regarding a possible Karner Blue introduction attempt (Brewer, 1974a); this confusion resulted in part from misinformation supplied by us to the *Wings* editor. The Karner Blue is believed to be extinct in the New York City area, and has only been recorded from Brooklyn on Long Island. In 1974, Bob Giffen, Ranger-Naturalist at Hoyt Farm Park, Commack, Long Island, New York, expressed an interest in attempting to introduce the Karner Blue at the Connetquot River State Park on Long Island, a 3600-acre tract of pine barrens quite similar to the Pine Bush. Giffen wrote to Dirig about a livestock source, but never obtained any ova, and no introduction was attempted. We have subsequently decided not to introduce the Karner Blue into any locality where it does not naturally occur for the following reasons. (1) This would be a breach of our ethics concerning the preservation of natural areas. (2) We do not know how the Karner Blue and other organisms in a potential introduction site would interact. (3) Because of this lack of knowledge, there is the distinct possibility of long-term genetic change in introduced Karner Blues or in other organisms affected by the Karner Blue introduction, especially if introduced Karner Blues were later to contact natural Karner Blue populations. (4) There is a good

chance for the preservation of most of the remaining natural Karner Blue populations, due to the development of significant local interest as a result of publicity about the butterfly. There is no reason to introduce Karner Blues into new areas if there is any chance of preserving natural populations. It is our belief that introductions should be employed for maintenance of a species or subspecies threatened with human-caused extinction only as a last resort, and even then, these must be very carefully monitored.

The Karner Blue ova that failed to hatch, mentioned in Brewer (1974b), were obtained by Irwin Leeuw of Cary, Illinois, from a wild-caught female taken in Allegan County, Michigan.

In August 1974, the New York State Department of Environmental Conservation published an article and map describing the preservation of over 350 acres in the Pine Bush (Anon., 1974). Copies of this article and map were sent by us to Jo Brewer and Robert Pyle, and both subsequently published synopses of the article (Brewer, 1974c, 1975; Pyle, 1974, 1976a, 1976b). The original article was in error, however. At the time it was published, the land had not yet been purchased for preservation. The property purchase agreement has still not been consummated, and as of this date no land in the Pine Bush has been officially preserved from development.

Objectives of the Karner Blue Project

The Karner Blue Project has two sets of objectives. One of these deals with the Karner Blue itself, the other with the peculiar kind of habitat to which it is restricted.

We have initiated a survey of all remaining plant communities in the Northeast that may support Karner Blue populations, so that the relict distribution of the butterfly, at least in the eastern part of its range, can be thoroughly mapped. We are interested in gathering and publishing data on these populations, when found, and in preserving them whenever possible. Thus far, efforts have concentrated on the large and endangered type population at the Pine Bush. We have discovered eight previously unknown populations of the butterfly in New York.

All Karner Blue populations we have observed were associated with light, sandy soils supporting a xeric vegetation. In the Northeast, these places usually are (or at one time were) dominated by Pitch Pine (*Pinus rigida* Mill.), and hence are known as "Pine Barrens." Such edaphic habitats, regardless of whether they support Karner Blue populations, contain a wealth of other specialized and often rare plants and animals, such as the Buck Moth. These habitats are rapidly disappearing, and with them will vanish hundreds of species of pine barrens endemics. They deserve much more scientific attention and preservation effort than they have received.

The Karner Blue Butterfly is a symbol of the northeastern Pine Barrens. We have adopted it as a graphic embodiment of our project, which has as its ultimate goal the preservation of as many of these xeric communities as possible.

Discussion and Conclusion

Readers of Xerces Society publications and other recent publications concerning the Karner Blue may have the erroneous impression that the Pine Bush has been preserved and the butterfly thus saved from extinction. Neither is true; the preservation of the Karner Blue is certainly not a "dead issue." On each visit to the Pine Bush we notice further developments. Hopefully, the listing of the butterfly as an endangered species in

New York State will aid in habitat preservation efforts, since this will make it illegal to kill or molest the butterfly in any way.

It is our understanding that the United States Office of Endangered Species does not plan to classify the Karner Blue as either "Threatened" or "Endangered" at this time (Paul A. Opler, personal communication), and we concur with that opinion. Because the subspecies ranges widely, it is not threatened with complete extinction. Nevertheless, the claim of Shapiro (1969) that it is the most localized northeastern butterfly may be justified. Presently its stronghold appears to be in Michigan. Although fully realizing the constraints and inconvenience involved in procuring collecting permits, we believe that listing of the Karner Blue as an Endangered Species in New York State is entirely proper, since there are so few (10) extant populations known throughout the state. Nearly all of these are in grave danger of obliteration from human disturbance. In New York, the only population not threatened by development occurs in Genesee County (Shapiro, 1969).

The Karner Blue is a very interesting butterfly from a biological standpoint; it is also very poorly known. Much additional field work is required before we can even begin to understand its natural history and distribution. Whatever assistance readers can provide in the form of sight and collection records, life history observations, photographs, locality information, and specimens would be very much appreciated.

Acknowledgements

Since the origin of the Karner Blue Project, many people have provided information or assisted us in other ways. We would like to acknowledge the help of the following persons: Harry A. Ahles; Glenn J. Applebee; Richard A. Arnold; Anita and James G. Barbour; Jo Brewer; William L. Brown, Jr.; Peter J. R. Buttner; Jim Cane; Robert T. Clausen; Charles V. Covell, Jr.; Robert P. Dana; Kit Dean; Dianne and Rodney Dirig; Harold J. Evans, Jr.; John G. Franclemont; Albert C. and Valeria Frederick; Heidi Hughes; Peter A. Hyppio; Roderick R. Irwin; Fay H. Karpuleon; Alexander B. Klotz; Walter A. Koenig; Jan K. Krepa; Roy Latham; Irwin, Leeuw; Ivy LeMon; Gerard Lemmo; Jack N. Levy; John M. Louis; Howard H. Lyon; Robert L. Miller; Robert A. Mitchell; Vladimir Nabokov; Mogens C. Nielsen; Larry J. Orsak; L. L. Pechuman; Albert M. Pellegrino; Rudolf Petersen; Doris and Henry Plant; Robert M. Pyle; Don Rittner; Robert Robbins; Steve Roman; Frederick C. Schlauch; Dale F. Schweitzer; Arthur M. Shapiro; David P. Shaw; Ray E. Stanford; Lowell Suring; Eduardo C. Welling; John A. Wilcox; LeRoy Wilcox; William D. Winter, Jr.; and Marjorie W. Woods.

Special gratitude is expressed to Richard A. Arnold, Larry J. Orsak, and David P. Shaw for reviewing all or portions of this paper before publication.

Finally, we gratefully acknowledge the encouraging support of the many people who wrote letters opposing development of the Pine Bush in the spring of 1975.

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Notes

Butterfly Conservation Problems in the Palestinian Region*

In the Palestinian region today, the lepidopterist finds an interesting situation which has developed from an overlay of biogeography and culture. The rich mix of faunal elements, in a land dominated by many centuries of heavy land use, creates a broad and challenging range of nature conservation dilemmas. I wish to relate a number of these problems as I perceived them while residing in Israel, where I conducted extensive field studies of Palestinian butterflies.

Two primary human activities have determined the present floral and faunal composition of the region – cultivation going back at least to the Biblical Period, and centuries of overgrazing by livestock (chiefly goats). About half of the Palestinian butterflies reach the southern limit of their dis-

tributions here, and are currently retreating to the north as the region continues to become drier, as it has been since the last glacial advance. Between climatic and human factors, many taxa are heavily stressed. The independence of Israel and its desire to become self-sufficient have placed nature conservation at a very low priority, and many new development projects impact butterfly habitats severely. On the other hand, the current military tension in the area offers inadvertent protection to numerous habitats in contested areas, on the frontier or in places reserved for military purposes.

In the Golan Heights, Israeli occupation in 1967 resulted in intensified agriculture by the native Druze population, as well as other developments which have drastically changed the entire area. The southernmost, very small populations of *Lysandra amanda anthaea* Hemming occur there, and I predict their extinction within the Israeli zone in the next few years as occupational pressures exacerbate. An historic ruin known as Tel Dan in Northern Galilee contains the

*This information was provided by Dr. Nakamura to Robert M. Pyle as a contribution to a world Lepidoptera conservation review. Dr. Nakamura has kindly permitted its adaptation for use in *Atala*.



Figure 1: *Iolais (Epamera) glaucus jordanus* Staudinger on its foodplant *Loranthus acaciae* Zucc. (Loranthaceae). The photograph was taken by the author on 14 July 1971, at Yotvata, ca. 40 kilometers (24.85 miles) north of Elat, Israel.

largest spring in the Lower Middle East, and here lives the southernmost population of *Pararge aegeria aegeria* L. The numbers were low, but the colony seemed relatively secure, inasmuch as the locality is a nature reserve. However, the Nature Reserve Authority has developed the site with facilities for extensive visitation. Heavy recreational use of the spring area threatens the *P. a. aegeria* population, which is widely disjunct from any other. One of the most devastating events for Palestinian wildlife was the drainage of the Huleh Swamp [discussed in depth by Furth in this issue]. Another large and important wetland drained by Jewish immigrants is the Yizrael Valley; here, the local *Tomares nesimachus nesimachus* Obthr. is feared extinct. In Western Galilee, cultivation progressively wipes out the lowland maquis flora which includes two species of *Aristolochia* (pipevine). These support a very few colonies of the papilionid *Allanastria cerisyi speciosa* Stichel. The only secure colony for this striking butterfly seems to be Mount Carmel. South of Mount Carmel in the Menashe region, the rare *T. nesimachus* (referred to above) is linked by its host plant to rich *terra rossa* soils. These soils also happen to be most suitable for agriculture, the advance of which threatens the extirpation of *nesimachus* in this region in the very near future.

The Coastal Plain, the most densely populated part of Israel, retains no butterflies of unusual interest. The Judean Hills, in contrast, harbor considerable diversity in pockets of wild vegetation among the ancient terraces of Biblical villages. Again, however, agricultural innovations on the Israeli side are inimical to this diversity. For example, the Arabs' donkey-pulled, wooden ploughs do not uproot the *Aristolochia* hostplants of *Allanastria deyrollei eisneri* Bernardi; mechanized ploughs do. Afforestation with *Eucalyptus* and conifers introduces another problem here, for it eliminates the undergrowth and its associated insect fauna. Butterflies which have apparently become much rarer and more local in the Judean Hills than previously recorded included *Papilio alexanor maccabaeus* Staudinger, *Aporia crataegi augustior* Graves, *Limenitis reducta schiffmuelleri* Higgins, *Pyrgus melotis melotis* Duponchel, *Muschampia proto heiromax* Hemming, *M. tessellum nomas* Lederer, *Thymelicus actaeon phoenix* Graves, and *T. lineola fornax* Hemming; all of these are near the southern limits of their ranges here.

Ein Geddi, a famed oasis on the western Dead Sea Coast, has recently been badly maligned by recreational use and water flow diversion. Two African species which reach their northern limits with endemic subspecies here are threatened by changes at Ein Geddi: *Colotis phisadia palaesinensis* Staudinger and *Iolus glaucus jordanus* Staudinger. The specific threat to the latter is destruction of *Acacia*, *Zizyphus*, and other trees which support the host of the butterfly, a parasitic plant (Fig. 1).

The Arava Valley, part of the Great Rift Valley, has been fairly well protected by the Israeli-Jordanian frontier and the mine fields. The tendency for new settlements to appear in this area gives cause for alarm, however, since it means draining of aquifers essential for the survival of the indigenous flora and fauna. Several resident and seasonally immigrant African butterflies occur only here in the region.

Three lycaenid butterflies are strictly endemic to the Sinai and Palestinian regions. While they are not critically endangered at present, they may each require some degree of protection in the near future. These are *Strymonidia jebelia*

Nakamura, *Iolana alfieri* Wiltshire, and *Pseudophilotes sinaicus* Nakamura. All Palearctic in origin, these butterflies probably represent a Pleistocene refuge fauna. Each is very local today, and in each case the threat is to the food-plant directly.

Clearly, the recent surge of human development in Palestine has made an impact on populations of many scarce butterflies. Further field exploration would enhance our knowledge of threatened and endangered insects in the region occupied by Israel and its neighbors. Enough is known already to say that unless specific conservation measures receive strict attention, a number of unusual and attractive butterflies may become extinct in the Palestinian region.

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Grasslands Institute, June 1976

I attended a Grasslands Institute sponsored by the Denver Audubon Society in June 1976, on the Pawnee National Grasslands. The rainy and very windy weather during this visit discouraged insect observation. However, the floristic diversity of the site supported the belief that these prairies would harbor a rich insect fauna. During a previous mid-summer excursion to the same area, around Briggsdale, Callippe Fritillaries (*Speyeria callippe* (Boisduval)) and Ridings' Satyrs (*Neominois ridingsii* (Edwards)) both flew prolifically. The present, rewarding state of the shortgrass environment here is particularly pleasing with respect to its history.

The national grasslands were not created to set aside superb examples of prairie communities, but to rescue lands which had been devastated by overgrazing, mismanagement, and drought, culminating in the Dust Bowl. As such, the national grasslands program has been a vast salvage operation. Faunistic surveys corroborate the success of the program. The situation is not, however, ideal. While grazing on the Pawnee National Grassland, the Central Plains Experimental Range, and the private lands in the area is carefully watched to prevent a recurrence of former abuses, conservationists are still wary of certain regional practices. For example, uranium mining accelerates on the Pawnee, and the threat of coal operations looms over the whole of the High Plains of the West. Ornithologists criticize a popular practice known as "pitting," whereby depressions are made in the prairie to aid water retention by the soil. Pitting demonstrably interferes with Mountain Plovers, the best indicator species of intact shortgrass prairie. We do not yet know whether this alteration affects prairie butterflies. Another agricultural activity which could certainly affect grass-feeding insects is the replacement of native grasses with the exotic Crested Wheatgrass (*Agropyron cristatum* (L.) Gaertn.). Of course, plowing the prairie totally disturbs the fauna. Fortunately, the aridity of the Pawnee arbitrates against large-scale plowing, and range managers assured us that pitting and grass replacement would not be carried out over a very large part of the area. Nonetheless all these activities warrant watching with

respect to their impact on rare insect populations.

Colorado lepidopterists do not doubt that notably rare lepidopterans occur on the Pawnee National Grassland, along with more widespread species. In a survey of possible rare and endangered Colorado butterflies prepared recently by Ray E. Stanford, a Director of the Xerces Society, several skippers considered threatened in Colorado were noted as probably occurring on the Pawnee Grassland: *Hesperia ottoe* Edwards, *Atrytone arogos* (Boisduval & Le Conte), *Atrytonopsis hianna* (Scudder), and possibly others. Clearly, the proper management of this area will have major implications for Colorado rarities. A committee of Colorado conservationists has been formed to investigate ways in which conditions as nearly natural as possible can be guaranteed on certain substantial parts of the grasslands. I represent entomological interests on this committee. One idea put forth represents a scenario in which Bison would be introduced to replace cattle as the principal grazers on a portion of a designated reserve.

One other matter of interest which arose from the Grasslands Institute concerns the proposed Narrows Dam. This shallow, water-retentive project would inundate a large amount of rich bottomland currently occupied by agriculture in the Platte River valley south of the Pawnee National Grassland. This might increase pressure to irrigate and plow the shortgrass uplands. A highly unpopular project among conservationists, the Narrows reservoir would drown a lengthy stretch of superb riparian habitat along the South Platte itself – broad benches dominated by Cottonwoods (*Populus* sp.) and willows (*Salix* sp.) and enclosing a wealth of communities in which little entomological work has been done. In fact, this dam might well prevent the rediscovery of *Lethe eurydice* (Johansson) in Colorado, which, according to Stanford, might only be expected in the scarce sedge marshes of the Platte watershed in the northeastern corner of the state. Participants in the Institute floated down the Platte through the endangered section. Especially when compared with the very few visible benefits of the project, the loss of an entire riverine system in this manner would be deplorable.

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The Lepidoptera Specialist Group Holds Its Inaugural Meeting

The inaugural meeting of the Lepidoptera Specialist Group (LSG) took place at the United States headquarters of the World Wildlife Fund in Washington, D.C., on 16-19 August 1976. Those participating represented three countries, while apologies and letters of interest arrived from invitees in all parts of the world. Present were John Heath, Norman Moore, and Michael Morris of Great Britain; Gerardo Llamas of Peru; and William Field, Paul Opler, Larry Orsak, and Robert Pyle (Chairman) of the United States. Initial discussion centered on the eventual composition of the Group, which will have members from as many affected countries as possible. The objectives of the LSG emerged as a straightforward

mandate to identify critical issues in the conservation of Lepidoptera and other insects, and to develop Action Programmes to deal with these issues. The conferees drafted an embryonic set of priorities in world Lepidoptera conservation management. Unanimously, they agreed upon firm protection of the recently discovered wintering grounds of the Monarch Butterfly (*Danaus plexippus* (L.)) in Mexico as the number one priority in butterfly conservation. Consensus also was reached that habitat conservation should be the primary concern of the Group and the essential element of most Action Programmes, with commercial collecting a very much secondary consideration (only in cases in which actual population reductions can be reasonably suspected). The Group does not believe that trade or private collecting impairs populations in most cases, but that habitat losses endanger a great many entire populations.

It is hoped by the participants in the first meeting that the LSG will serve to clarify what should and can be done to preserve natural populations of the most crucially threatened insects of the world.

A report on the first meeting is in preparation and will soon be available to seriously interested persons. This will discuss additional points considered by the LSG to be of outstanding importance. Suggestions for the attention of the Group will be welcomed and fully considered, especially if accompanied by data. Please send communications or queries about the LSG to the author.

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Disappearance of Lepidoptera in Indiana and Ohio

While living in Indiana for the past 15 years, I have failed to find some of the Lepidoptera reported to exist in the state. Perhaps these were plentiful years ago, but they seem to be absent today. Few people take me seriously when I say that most of the specialized feeders will be extinct here before too many more years have passed.

A few years ago I lived in Canton, Ohio. Many of the homes there had Dutchman's Pipe vines (*Aristolochia* sp.) growing around the porches. Pipevine Swallowtail larvae (*Battus philenor* (L.)) were so common that they were the nemesis of many housewives who destroyed the "ugly critters" (they were beautiful to me), and this swallowtail was one of our most common species. A recent visit to Canton suggested that they are all gone – none of the vines are left, hence no *B. philenor*. I am told that the butterfly feeds on Wild Ginger (*Asarum canadense* L.), which grows here, but I have never seen this plant nor the swallowtail itself in the vicinity.

There was also an area where Tuliptrees (*Liriodendron tulipifera* L.) grew, and the Tuliptree Silkmoth (*Callosamia angulifera* (Walker)) was fairly common. The *Liriodendron* went due to housing developments, and with the trees, the moths vanished.

Along the Ohio River near Yorktown, Ohio, in a dense stand of Pawpaw (*Asimina triloba* (L.)), I could find all

stages of the Zebra Swallowtail (*Graphium marcellus* (Cramer)) by the hundreds. That area was taken over by a steel milling operation, and not a single Zebra Swallowtail remains. When I lived in suburban Cleveland after the war I saw an occasional *G. marcellus*, and eventually located a good stand of Pawpaw. The farmer who owned the property told me that the Zebra Swallowtails that were so common had been there for generations. A recent visit to the site made me a little sick -- all a new real estate development, and no more swallowtails, for their foodplant is gone.

When I moved to Indiana in 1960, I surveyed the area. I found *G. marcellus* occasionally, and also the Giant Swallowtail (*Papilio cresphontes* Cramer). I knew that they are specialized feeders, and set out to locate Pawpaw and Prickly Ash (*Xanthoxylum americanum* Mill.), both of which I found. I planted some of these trees on my property, in hopes that both butterflies might colonize the site. Before that could happen, the native stands of Pawpaw and Prickly Ash were destroyed by builders, farmers, and weed-killers. Both swallowtails now appear to be locally extinct.

Perhaps the most common large lepidopteran in the area was the Prometheus Moth (*Callosamia promethea* (Drury)). The country roads and railroad rights-of-way were lined with Sassafras (*Sassafras albidum* (Nutt.) Nees.), on which Prometheus cocoons could be found by the hundreds in winter. Both the highways and the railroad have been sprayed with herbicides; unpoisoned trees and shrubs have been cut down and destroyed. The few surviving Prometheus fall prey, in the larval stage, to birds or other predators, or are parasitized. I have released some adults, only to watch Blue Jays swoop down quickly for a meal.

I predict that in the near future, the only specimens of once-common butterflies and moths will be found in museums and collections. It is a worldwide catastrophe. It has already happened here, and few people appear to care. I really don't know what the Xerces Society can do to save the Lepidoptera. The generation today seems uninterested: Greed has become the way of life. My comments all seem very negative. I am on the board of the Merry-Lea Environmental Center at Wolf Lake, Indiana, which consists of several hundred hectares (acres) that we are trying to preserve for posterity. Of course, butterflies and moths are preserved along with other wildlife and plants.

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Symposium on Endangered Insects Held at the XVth International Congress of Entomology, Washington, D.C., in August 1976

For the first time, an International Congress of Entomology included a full symposium on conservation in its program. The symposium, titled "Endangered Insects of the World," was organized for the XVth Congress by Paul Opler of the Office of Endangered Species, U.S. Department of the Interior. Several Xerces Society members presented papers for the symposium: Charles V. Covell, Jr., John Heath, Norman Moore, Michael Morris, Larry J. Orsak, Jerry Powell,

Jeremy Thomas, and Robert Pyle. (The contributions to this symposium may be published as a single volume.) One symposium speaker felt that the presence of only about one percent of Congress delegates (numbering in the thousands) at the symposium was a symptom of the largest problem in conservation: awareness. Even so, the pioneering event succeeded very well in inserting a responsible conservation theme into the most important world entomological gathering, which for so long has held insect pest eradication as its major emphasis. It was significant that Curtis W. Sabrosky, President of the Congress, mentioned rain forest butterfly conservation in his ecologically balanced presidential address.

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A Summary of the Endangered Species Act

The *Endangered Species Technical Bulletin* is a new monthly publication issued by the Office of Endangered Species in Washington, D.C. Some of the information contained in recent issues of this newsletter is abstracted below.

LISTING, DELISTING, AND RECLASSIFYING A SPECIES: All organisms, including butterflies, proposed for placement on the Endangered Species List have to be considered via the following steps before this status is established: (1) A request or petition by individuals or organizations is made to the U.S. Fish and Wildlife Service for action on a species; this must be supported by evidence of endangerment. (2) A review of the evidence is conducted by an ad hoc panel of professional biologists to determine a course of action. Possible actions include further review of species status; immediate publication of a proposed rulemaking in the *Federal Register*; or no further action, if there is insufficient evidence to warrant it. (3) "A Notice of Intent to Review the Status of a Species" may or may not be published by the Fish and Wildlife Service in the *Federal Register*. State governors are given a 90-day period in which to comment on affected species indigenous to their respective states. Individuals' comments also are solicited. (4) The Fish and Wildlife Service makes a decision either to drop the species from consideration or to develop a "Proposed Rulemaking." (The Fish and Wildlife Service acquires its own evidence on the species.) (5) A notice of "Proposed Rulemaking" is published; the public is given 60 days to respond, state governors 90 days. Public hearings on the proposed rulemaking may be requested by anyone during this period. (6) The Fish and Wildlife Service makes a decision utilizing these comments and available evidence. (7) If a decision is made to list an organism as endangered or threatened, a "Final Rulemaking" is drawn up and published in the *Federal Register*. Common and scientific names of the species and its status on the Endangered Species List are given. The range in which the species is either threatened or endangered is indicated, as well as supporting data for the rulemaking and any special regulations applying to the species.

RECOVERY TEAMS: These are groups of biologists (usually Federal and State agency employees) appointed

by the Fish and Wildlife Service to study the biological status of a given threatened or endangered species. A primary goal of each recovery team is to develop a Recovery Plan, a step-by-step list of recommendations outlining efforts needed to improve the status of that species. The ultimate goal is to bring about the removal of that species from endangered or threatened status.

CRITICAL HABITAT: Under the Endangered Species Act of 1973, Section 7, the land, water, and air space needed for the normal survival of a given species are termed its *critical habitat*. Critical habitat has been designated (or proposed) for the California Condor and American Crocodile. Federal agencies are charged with the responsibility of preventing the destruction or adverse modification of any part of this critical area by actions authorized, funded, or carried out by them. The actions of private individuals and State agencies are not affected *unless* funding or approval from a Federal agency is involved.

A free copy of the *Endangered Species Act of 1973* is available from the Office of Endangered Species, U.S. Fish and Wildlife Service, Washington, D.C. 20240, USA. All persons interested in conserving threatened and endangered organisms and preserving their habitats should have a copy of this law.

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More on Dams and Butterflies

Shortly after the editorial on dams and butterflies appeared in the previous number of *Atala* (3(2) : 37), I was delighted to hear that a Hell's Canyon National River bill had cleared Congress and been signed by President Ford. This great success on the part of conservationists ends the long battle to prevent damming of the deepest canyon in the United States. Incidentally, it will mean the protection of riverine habitat for such rare butterflies as *Papilio oregonius* Edwards and *Parnassius clodius shepardii* Eisner. In the same editorial it was stated that the proposed Benjamin Franklin Dam in Washington State would back up the last wild stretch of the Columbia River "between the McNary Dam pool and the city of Richland." In fact, McNary Dam lies downstream of Richland, while the undammed stretch of the Columbia River is upstream of the city.

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Book Review

A New Book on *Catocala*

Legion of Night: The Underwing Moths, by Theodore D. Sargent, photographs by Harold J. Vermes, drawings by Katherine A. Doktor Sargent; xiii + 222 pp., 8 color plates, many black and white drawings and photographs; 1976. University of Massachusetts Press, Amherst, Massachusetts 01002, USA. \$15.00.

This book is intended to appeal to a diverse audience, including amateur naturalists and lay people, as well as professional biologists. The writing is quite precise, appropriately concise, highly readable, and not in the least stuffy or pretentious. The inclusion of abundant data (much of it as appendices) and literature citations gives this book a great deal more authority than is usual for semipopular writing. The inclusion of a glossary of entomological and biological terms should aid many readers. The bibliography is quite extensive. The book is not a taxonomic work, but it does resurrect some unsolved and generally overlooked taxonomic questions. No new species are described; a few new melanic forms are given *informal* names.

A great deal of emphasis seems to have been placed on aesthetics. This factor, plus the enjoyable writing style, make reading *Legion of Night* a very different experience from that of plodding through a "scholarly journal." Moths have traditionally been associated with death or mystery in various cultures; this idea seems to have consciously been made a part of this book, beginning with the dust jacket. Certainly a more sombre or mysterious design would have been difficult to conceive. The black figure illustrated is a quite recognizable rendering of the ventral wing surfaces of *Catocala miranda* H. Edwards, probably the most sombre American species – and certainly one of the least known.

Chapter I ("Of Men and Names") deals with several prominent nineteenth century entomologists who together named most of the American *Catocala* at least once. It includes quotes from old passages which illustrate their often bitter personal rivalries. Having been largely forgotten in the present century, these make interesting reading.

Chapter II ("A Fertile Theme") is designed to facilitate identification of eastern North American *Catocala* (including forms) and to provide brief summaries of their ranges and foodplant preferences. Color illustrations of 126 specimens representing 71 species are given. The book is by far the most reliable and accurate source of *Catocala* host-plant information that has been published. Only one record seems dubious: that of Wax-Myrtle or Candleberry (*Myrica cerifera* L.) for *Catocala badia* Grote & Robinson, since the plant and moth are nearly allopatric. (This species in fact feeds mostly or entirely on Bayberry (*Myrica pensylvanica* Loisel.)) Some foodplant records were previously unpublished.

The range descriptions are generalized, but more up-to-date than any other published ones. In some cases I wish they had been given in greater detail, especially the southern limits. At least mention of whether specific captures had been made in mountainous areas or elsewhere would have been helpful. The brief descriptions do, however, give a good idea of what the various ranges have been within the past

100 years. Evidence is given that ranges are not constant, and the inclusion of comments on present "status" of the individual species is useful.

One fairly novel and very useful feature is the inclusion of selected *ventral surface* figures. In some species (e.g., *miranda*), underside characteristics are the safest for identification.

Chapter II will be of help to any Xerces Society members who might wish to determine which, if any, local *Catocala* species or important populations are in trouble from human intervention.

Chapters III and IV ("The Lure of Sugar" and "The Lure of Light," respectively) deal with the time-honored moth collecting practices of "sugaring" and attracting with lights. The conclusions reached are based on real data, which are included. Although diurnal collecting is not treated in detail, it is hardly surprising that the Mercury Vapor Robinson Trap was found to be the best sampling device. However, most species came most readily to bait, although the data show this technique to be rather erratic in yield. Sex ratios of moths collected by the various methods are also given. (I might note that light collecting results range from poor to nil in urban/suburban areas, due in large part to the presence of mercury vapor street lights. In such a setting, bait results are sometimes good, however.)

Chapter V ("Of Sports and Sporting") is perhaps a little harsh on collectors, but should occasionally be read by all who collect moths. Sargent makes it clear that collecting can be a scientifically valuable enterprise if properly done – or it can be little more than an "ego trip." The chapter also deals with the significance and definition of "sports" (or *aberrations*, as many call them). There is a good discussion of inter-specific hybrids (and the paucity thereof) in the *Catocala*. Two very likely examples which I have seen are described and illustrated. Some mention of *Catocala badia* var. "phoebe" H. Edwards would have been appropriate here. It is certainly possible that the few "phoebe" specimens from southern Maine and New Hampshire are hybrids between *C. badia* and *C. coelebs* Grote. (Most specimens I have seen come from *C. coelebs* populations.) Var. "phoebe" is briefly mentioned in Chapter II.

Chapter VI ("Twixt Birth and Death") deals with the basic life histories of *Catocala* in terms readily understandable to a lay person. Rearing techniques are discussed and a number of fine photographs of larvae and mating pairs are included. This chapter begins to explore the biologically most interesting aspect of these moths: their incredible sympatric diversity. The author's fascinating ideas and data are given and the need for more basic knowledge of behavior and other aspects of their life histories is emphasized.

The final two chapters (VII, "Designs for Deceit," and

VIII, "Designs for Display") are truly outstanding; they deal with the functions of the cryptic forewings and contrasting hindwings and various related behaviors. Many hypotheses have been made over the years regarding these, but Sargent seems to have been the first person to test any of them scientifically. His previously published results are summarized and expanded upon. Relevant theoretical discussion is included. The phenomenon of industrial melanism as it applies to *Catocala* is discussed, and the apparent non-universality of the classic explanation (cryptic advantage) is pointed out.

There are a very few minor errors, mostly typographical (e.g., "Barberry" for Bayberry on page 40). There are no errors in identification. The one serious shortcoming of this book is the rather poor reproduction of the color plates. I have seen the original proofs, which were superb. The blame clearly lies with the printer. For identification purposes, though, they should be adequate, with the exception of some figures on Plates 2 and 8. Persons using any of these plates for identification purposes should be aware that the colors are not always quite right.

Fortunately, the superb drawings of Katherine Sargent reproduced very well. All are excellent. The large larva in the drawing which serves as a frontispiece for Chapter VI looks as if it might drop off if touched. The shower of *Catocala* wings preceding Chapter II is captivating, and the

Biblical quote well chosen. My favorite is her drawing of a Blue Jay and a *Catocala ultronia* (Hübner) which introduces Chapter VIII, with its accompanying quote from Shakespeare. The drawings are helpful as illustrations, and add immeasurably to the aesthetic appeal of the book.

Some Xerces Society members will doubtless feel that more attention should have been given to conservation in this book (I have, in fact, heard this comment). Perhaps so, but what else could really have been said with any authority? No one knows why *Catocala* numbers fluctuate. Many ranges seem to have contracted recently, while many others have also expanded. Some species are moving into new areas, following the transplanting of their natural or recently acquired hostplants. Few species are known to be restricted to special habitats, most occurring in ordinary wooded areas. We need more research on this aspect of the *Catocala* - soon.

I should state that I have been associated with the author as a graduate student, although I am no longer in residence at the University of Massachusetts. Even so, I believe my review is fair, and I recommend this book enthusiastically to all naturalists, lepidopterists, and evolutionary biologists. It is refreshing to see such an effort directed at the study of Lepidoptera (or, for that matter, any *wild* insects) as something other than objects to be classified or pests to be sprayed.

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Abstracts of Recent Literature

Recent and previously overlooked papers will be briefly summarized in each number. Suggestions, references, and reprints are requested, so that this service can be maximally useful to readers. A photocopy of any paper abstracted in this column is available for personal use at cost (US 3¢ per page), plus postage, from the compiler, Larry J. Orsak (address on inside back cover). Abstracts were written by the compiler and by the Editor-at-Large.

Politics and Issues

Christensen, G. 1975. Wer rottet aus...? Entomol. Z. 85(21): 246-248.

Geiger, H. 1975. Schmetterlingssammler und Naturschutz. Entomol. Z. 85(23): 261-262.

Reimann, O. 1975. Ausrotten oder bewahren helfen? Entomol. Z. 85(24): 273-274.

Christensen defends collectors and insect collecting against the charges that both contribute in great part to the extermination of insects. Geiger replies that in Switzerland, protection of other organisms has largely been a result of ornithological and botanical pressure groups, and urges entomologists to follow this example. Reimann feels that the great majority of collectors collect not for science, but for personal pleasure or profit, and that there is substance in the charges against them.

Fish and Wildlife Service. 1976. FWS protects insects for first time. Fish & Wildlife News, September 1976: 1, 4. The rationale and process for the recent listing of eight butterflies as threatened or endangered by the United States Office of Endangered Species are presented by the agency responsible. Awareness of the need for insect conservation is growing. FWS recognizes dune destruction as a major threat to certain lepidopterans.

Miller, S. E. 1975. Butterfly conservation. Museum Talk (Santa Barbara Mus. Nat. Hist.) 49(1): 19-21. A brief survey article which emphasizes the need for specific habitat reservation and public awareness.

Moriarty, F. 1975. Where have all the butterflies gone?, Chapter 6, pp. 81-97. In Pollutants and Animals, a factual perspective, George Allen & Unwin Ltd., London. Contains a popular discussion of the author's research, some of the only hard, experimental work which has been done on butterflies vs. pesticides. Populations have not suffered to the extent popularly believed from insecticides, but certain important sub-lethal effects can be observed, and there is certainly some impact.

Morris, M. G. 1976. Conservation and the collector, pp. 107-116. In Heath, J. (ed.), The Moths and Butterflies of Great Britain and Ireland, Vol. I (Micropterigidae — Heliozelidae), Blackwell, Oxford. An appraisal of the need for and organization of British nature conservation as it relates to Lepidoptera. The collecting/anticollecting controversy is resolved by a thorough consideration of the facts. A "moderate and constructive approach to insect conservation" keynotes the chapter, which details what individuals can do for conservation.

Pyle, R. M. 1976. Conservation of Lepidoptera in the United States. Biol. Conserv. 9: 55-75. The development of the butterfly and moth conservation movement in the United States is followed from the earliest instances to the present. Examines the origin and growth of the Xerces Society, and the factors surrounding principal threatened lepidopteran situations. Critical needs in Lepidoptera conservation research and policy are identified, and actions to meet them are suggested.

Pyle, R. M. 1976. The scientific management of butterfly and moth populations; a new thrust of wildlife conservation. Discovery (Yale Peabody Mus. Nat. Hist.) 11: 68-75. Lepidoptera have resource values, among them ecological indicator capacity, research subjects, and esthetic appeal. People in the United States are only now beginning to realize that many lepidoteran populations are declining, and a butterfly conservation movement has grown and coalesced with the formation of the Xerces Society. Habitat management can be applied to conserve rarities; particular needs lie in the California, Florida, and northeastern areas of the country. Author explains how field research, including collecting, aids applied conservation management, and why museum collections are essential to conservation-based studies.

Biogeography and Faunistics

Duffey, E. 1974. Changes in the British Spider Fauna, pp. 293-305. In Hawksworth, D. (ed.), The Changing Flora and Fauna of Britain, Syst. Assoc. Spec. Vol. No. 6, Academic Press. Land use changes are thought to be responsible for the extinction or loss of two of the 611 British spiders. Populations of other species have apparently declined, perhaps due to falling water tables in the fens. The apparent rarity of many species appears to be due to insufficient knowledge of their biology. Few of the species appear to be restricted to a single well defined habitat, but these species would benefit by protection and appropriate habitat management.

Gfeller, W. 1975. Geschützte Insekten in der Schweiz (Protected insects in Switzerland). Mitt. Schweiz. Entomol. Ges. 48: 217-223. Examines the protection of insects under Swiss law from a lawyer's perspective. Only the Large Red Wood Ant (*Formica rufa*) is protected throughout Switzerland, but three cantons have laws protecting some butterflies. Several rare parnassians receive protection in these cantons, but certain common butterflies may likewise not be collected. The laws do not address habitat protection.

Heath, J. 1974. A century of change in the Lepidoptera, pp. 275-292. In Hawksworth, D. (ed.), The Changing Flora and Fauna of Britain, Syst. Assoc. Spec. Vol. No. 6, Academic Press. Changes in range and abundance of Lepidoptera in Britain are

reviewed. Habitat and climatic changes are considered responsible for distributional shifts and changes in abundance, habitat alteration being the primary cause of decline. Expansion or decline of range is mapped for 10 species.

Heath, J. 1975. Biological recording in Europe. *Endeavor* 34: 103-108. A permanent computerized system used in Britain for handling and processing biological data on the European flora and fauna (primarily British) is described and discussed, with emphasis on its use in locating declining organisms.

Nagy, B. 1974. Reliktum Saltatoria fajok a pusztulo Belko hegyen. *Folia Entomol. Hung., Rovartani Kozlemenyek* (series nova) 27(1): 139-144. The extinction of three orthopteran populations from Belko in the Bukk Mountains, Hungary, is documented, the loss a result of human disturbance. Populations were relicts on the northern limits of species ranges.

Pyle, R. M. 1976. The Eco-Geographic Basis for Lepidoptera Conservation. Unpublished Ph.D. thesis, Yale University. 309 pp. (Available hardbound from University Microfilms, Box 1764, Auburn, Michigan 48106, USA, @ US \$15.00.) Butterfly biogeography is employed to define biotic provinces for Washington State. These are compared with existing nature reserve distribution to define future reservation priorities. In a separate section, world Lepidoptera conservation problems and approaches are reviewed.

Schmidt, E. 1974. Faunistisch-okologische Analyse der Odonatenfauna der Nordfriesischen Inseln Amrum, Sylt, und Fohr. *Faun. Oekol. Mitt.* 4: 401-418. Dragonfly fauna of three German islands are analyzed. Domestic ducks are cited as a cause of population extinction through destruction of pond vegetation.

Ecology, Habitats, and Management

Dempster, J. P., M. L. King, & K. H. Lakhani. 1976. The status of the swallowtail butterfly in Britain. *Ecol. Entomol.* 1: 71-84. An important analytical study of the autecology of the threatened British Swallowtail (*Papilio machaon britannicus*). Possible reasons for extinction of the butterfly at Wicken Fen are discussed, along with evolved differences between the Wicken and Norfolk Broads populations. The experimental results bear upon efforts to conserve the Swallowtail in Norfolk and reintroduce it at Wicken Fen.

Hardy, A. R., & F. G. Andrews, principal investigators. 1976. A final report to the Office of Endangered Species on contract 14-16-0008-966. 47 pp. The beetle fauna of a series of California sand dunes is surveyed, listed, and discussed; 22 locally endemic species are recommended for protection

because of off-road vehicle damage to the fragile dune ecosystems.

Lawton, J. H., U. J. Blumenthal, & A. Fisher. 1974. A survey of the invertebrates of the Pocklington Canal. *Naturalist (Yorkshire, England)* 928: 19-24. Assesses the probable effects of dredging a Yorkshire canal on a rich, well established aquatic invertebrate fauna. While local extinctions occurred, most species present will probably find refugia within the system and re-disperse as the canal recovers.

Limbert, M. 1975. The gatekeeper butterfly in Yorkshire. *Naturalist (Yorkshire, England)* 934: 111-114. The status of *Pyronia tithonus* in Yorkshire is examined with reference to human impacts on habitats. Many former colonies have been destroyed, due to agricultural and other changes.

Moore, N. W. 1975. The conservation of Odonata in Great Britain. *Odonatologica* 5: 37-44. Extensive changes in natural aquatic habitats and introduction of artificial ones have caused the diminution of some species of dragonflies and damselflies and the increase of others. Three species have apparently become extinct in Britain since 1950, one on a Site of Special Scientific Interest, through sewage works pollution. Three others have been seriously reduced. Creation of nature reserves, implementation of new aquatic habitats, reintroduction of extinct fenland odonates, and pollution abatement are being pursued.

Owen, J. & D. F. Owen. 1975. Suburban gardens: England's most important nature reserve? *Environ. Conserv.* 2: 53-59. Butterflies, hover flies, and ichneumonid wasps were systematically sampled with a Malaise trap and other means in a suburban garden in Leicester. A surprisingly high diversity of each was recorded, when compared with the faunas as known for the British Isles and Monks Wood National Nature Reserve. The authors contend that the value of the million or more acres of British gardens as species reservoirs is both high and neglected.

Pierce, J. 1976. All for a vanishing butterfly. *Field*, 3 June 1976: 1021-1022. A brief article on the conservation aims and prospects for the Large Blue (*Maculinea arion*) in England.

Previously Overlooked

Anonymous. 1925. The protection of insects. *Entomol. News* 36: 272-273. Reports that the American Entomological Society has adopted a resolution expressing serious concern and disapproval over the use of beautiful insects for art and jewelry purposes.



Announcements & Notices

Acknowledgements

This issue is the combined effort of many people. Because it is the first *Atala* to be typeset, a great deal of time was required to define editorial policies and decide on a new format. I hope you will feel it was worth the wait.

Richard A. Arnold, Frederick C. Schlauch, and David P. Shaw kindly reviewed several articles and notes and made many very valuable suggestions. Helpful advice or expertise was provided by Jo Brewer, John G. Franclemont, George L. Godfrey, Peter A. Hyypio, L. L. Pechuman, and William D. Winter, Jr. Don Rittner granted permission to reproduce the copyrighted drawing used with the article on the Karner Blue Project; this originally appeared in *Pine Bush -- Albany's Last Frontier*.

John F. Cryan, Larry J. Orsak, and Robert M. Pyle, the other editors, contributed much in helping to establish editorial policies and develop format. Richard A. Arnold and Frederick C. Schlauch also lent much assistance in this regard.

Especial thanks to John F. Cryan for much advice and support and for assisting with the layout.

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SUGGESTIONS FOR CONTRIBUTORS

Formal scientific articles and notes dealing with any aspect of the ecology and conservation of endangered or threatened terrestrial arthropods are solicited. Articles will generally be longer papers, notes not exceeding 1000 words. Reviews of books dealing with terrestrial arthropod conservation or endangered habitats are also invited. Appropriate philosophical papers will be welcomed for use in the "Commentary" section.

All manuscripts should be typewritten on white, 8½ x 11 inch, good quality bond paper, on one side only, double- or triple-spaced throughout, with margins of at least one inch on all sides. The original typescript and at least one (preferably two) xeroxed or carbon copies should be submitted; authors should also retain a copy of manuscripts and figures for later consultation with the editors.

Please include illustrations if appropriate. Figures should be consecutively numbered in Arabic numerals. Hand-drawn figures should be rendered in black ink on good quality white paper. They may be larger than final reproduced size. Black and white glossy photographs may also be submitted. These and artwork will be returned after publication if accompanied by return postage. Figure captions should be typed, double-spaced, on a separate sheet, and the number of the figure lightly pencilled on the back of each drawing or photograph. A sketch map should be included as a figure with all articles or notes dealing in a major way with a specific region or arthropod habitat.

Cover art changes with each issue, and contributions will be gratefully received. Cover illustrations should generally show insects or other arthropods in *living* poses, and prospective cover artists should consult with the Editor before submitting material.

Tables should be numbered consecutively in Arabic numerals and submitted in photo-ready condition on separate sheets. Please include full scientific names, *with authors*, for both plants and animals mentioned in any manuscript submitted for publication in *Atala*. The metric measurement system should be used, with English system equivalents in parentheses if desired. Full references to literature cited should appear in a separate section at the end of articles or commentary papers, but should be parenthetically incorporated within the text of notes. Please include an *informative abstract* of approximately 150 to 250 words with all articles. Avoid footnotes to text statements if possible; such information can usually be included within the text. Words to be set in *italics* should be underlined. Reprints of articles are available at cost. An author will receive a reprint order form after acceptance of a manuscript. The style of *Atala* generally follows that recommended in the *CBE Style Manual* (1972). Abbreviations of journal titles follow *Bibliographic Guide for Editors and Authors* (1974).

Prospective authors may request a copy of the detailed editorial policy of *Atala* from the Editor.

COVER

The beautiful yellow and purple Imperial Moth (*Eacles imperialis* (Drury)) is one of the rapidly disappearing northeastern United States saturniids. In this midsummer nighttime view, set in a dry oak-pine woods typical of many areas with shallow, infertile soil in the Appalachian Mountains, a newly-emerged female Imperial Moth clings to the trunk of its larval host, Pitch Pine (*Pinus rigida* Mill.). Males quickly sense the pheromone released by the female and follow upwind to its source. Massive habitat alterations have evidently caused the demise of many local populations of this magnificent insect in the heavily urbanized Northeast. (See the article on disappearing moths by Sidney A. Hessel in this issue.)

The drawing was rendered in India ink using an ultrafine-pointed crowquill pen by Robert Dirig, and is reproduced approximately 90 percent natural size.



Dirig